THE ORTHOSIINAE REVISITED (APOCYNACEAE, ASCLEPIADOIDEAE, ASCLEPIADEAE)[1]

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ABSTRACT

The subtribe Orthosiinae (Apocynaceae, Asclepiadoideae, Asclepiadeae) is monophyletic and comprises four genera. *Monsanima* Liede & Meve is herein validly established, comprising one species, *M. morrenioides* (Goyder) Liede & Meve. This new genus is sister to a clade consisting of *Jobinia* E. Fourn., *Orthosia* Decne., and *Scyphostelma* Baill. A taxonomic key to these four genera is provided. For *Jobinia*, one species, *J. peruviana* Liede & Meve, is newly described, and 13 species previously treated principally under *Cynanchum* L. are transferred, so that the genus now comprises 25 species. *Jobinia fontellana* Liede & Meve is proposed as a new name, replacing *O. hatschbachii* Fontella & Goes. The following new combinations are made in *Jobinia*: *J. canoi* (Morillo) Liede & Meve, *J. formosa* (N. E. Br.) Liede & Meve, *J. latipes* (Decne.) Liede & Meve, *J. mazzuchii* (Speg.) Liede & Meve, *J. samuelssonii* (Malme) Liede & Meve, *J. schizocorona* (Liede & Meve) Liede & Meve, *J. streptantha* (Malme) Liede & Meve, *J. tarmensis* (Schltr.) Liede & Meve, *J. tiarata* (Malme) Liede & Meve, *J. trifurcata* (Griseb.) Liede & Meve, and *J. umbellata* (Rusby) Liede & Meve. In *Orthosia*, the new combination *O. angustifolia* (Turcz.) Liede & Meve is made. *Orthosia thymifolia* Schltr. is excluded from the genus and the new combination *Ditassa thymifolia* (Schltr.) Liede & Meve (Metastelmatinae) is proposed. The genus *Scyphostelma* is reinstated, and 26 species, most previously in *Cynanchum*, are transferred: *S. beckii* (Morillo) Liede & Meve, *S. bifida* (Liede & Meve) Liede & Meve, *S. brachyphylla* (K. Schum.) Liede & Meve, *S. carmenaemiliae* (Morillo) Liede & Meve, *S. chimboracensis* (Morillo) Liede & Meve, *S. confusa* (R. W. Holm) Liede & Meve, *S. ecuadorensis* (Schltr.) Liede & Meve, *S. filisepala* (Standl.) Liede & Meve, *S. harlingii* (Morillo) Liede & Meve, *S. intricata* (K. Schum.) Liede & Meve, *S. isidrensis* (Morillo) Liede & Meve, *S. lechleri* (Morillo) Liede & Meve, *S. longecalicina* (Morillo) Liede & Meve, *S. luteynii* (Morillo) Liede & Meve, *S. microphylla* (Kunth) Liede & Meve, *S. nubicola* (Morillo) Liede & Meve, *S. pichinchensis* (K. Schum.) Liede & Meve, *S. ruizteranii* (Morillo) Liede & Meve, *S. serpyllifolia* (Kunth) Liede & Meve, *S. siderocalyx* (Morillo) Liede & Meve, *S. sodiroi* (K. Schum.) Liede & Meve, *S. tenella* (L. f.) Liede & Meve, *S. trianae* (Schltr.) Liede & Meve, *S. veleziae* (Morillo) Liede & Meve, *S. velutina* (Morillo) Liede & Meve, and *S. wurdackii* (Morillo) Liede & Meve. Ten names are lectotypified: *C. ecuadorense* Schltr., *J. formosa*, *J. tarmensis*, *J. tiarata*, *J. trifurcata*, *J. umbellata*, *S. brachyphylla*, *S. ecuadorensis*, *S. intricata*, and *S. pichinchensis*. Three names are neotypified: *J. chlorantha* (K. Schum.) Malme, *S. sodiroi*, and *S. trianae*.

Key words: Apocynaceae, Asclepiadoideae, Central America, *Cynanchum*, *Jobinia*, *Monsanima*, *Orthosia*, Orthosiinae, *Scyphostelma*, South America.

Orthosia Decne. was described by Decaisne (1844), based on *O. congesta* (Vell.) Decne., a Brazilian species, and Decaisne also attributed five more species to *Orthosia*: *O. umbrosa* Decne., *O. kunthii* Decne., *O. serpyllifolia* (Kunth) Decne., *O. arenosa* Decne., and *O. suberosa* Decne. By 1932, Fournier, Grisebach, Malme, and Schlechter added some 20 additional names to the genus. However, *Orthosia* was associated with those genera merged under the extended concept of *Cynanchum* L. by Woodson (1941). Only Fontella Pereira and Valente (1969) would thereafter publish a species under this generic name as *O. loandensis* Fontella & C. Valente, but they did so without comment on the generic circumscription of the taxa. Liede (1997), based on morphological studies, rejected the enlarged genus sensu Woodson (1941) for *Cynanchum* and suggested the reinstatement of *Orthosia* to include *Amphistelma* Griseb. She (Liede, 1997) listed 61 names considered to belong to *Orthosia*, of which 22 were so far known

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under *Orthosia*, with 10 names under *Amphistelma*, 24 in *Cynanchum*, four in *Metastelma* R. Br., and one within *Tassadia* Decne. However, Liede (1997) refrained from large-scale nomenclatural changes, suspecting a high degree of synonymy in these names, of which many were applicable to incompletely known taxa. The independence of *Orthosia* from *Cynanchum* was demonstrated hence by molecular studies (Liede & Täuber, 2002).

Recent molecular studies (Rapini et al., 2003, 2006; Liede-Schumann et al., 2005) have shown that more than three quarters of the roughly 1000 American species of the Asclepiadoideae (Meve, 2002) belong to a single large radiation, termed the MOOG clade (Liede-Schumann et al., 2005: fig. 1). The MOOG clade comprises the four subtribes Metastelmatinae Endl. ex Meisn., Orthosiinae Liede & Rapini, Oxypetalinae E. Fourn., and Gonolobinae G. Don ex Liede, each with several genera, and three genera not attributable at present to any of these subtribes (*Pentacyphus* Schltr., *Diplolepis* R. Br., and *Tassadia*).

Although Gonolobinae and Oxypetalinae morphologically constitute easily recognizable units of long taxonomic recognition (e.g., Schumann, 1895), the separation of Orthosiinae from Metastelmatinae was unsuspected. However, Woodson (1941) actually did include members from both subtribes into his enlarged *Cynanchum*. This background, together with the insignificant and hard-to-distinguish flowers for many taxa of the Orthosiinae and Metastelmatinae, has for a long time hampered our taxonomic understanding of these two subtribes and of American Asclepiadoideae as a whole.

From the analysis of Liede-Schumann et al. (2005) and that of Rapini et al. (2007), it became apparent that Orthosiinae, aside from *Orthosia* and *Jobinia* E. Fourn., encompasses many species of Woodson's (1941) enlarged *Cynanchum* that do not immediately associate with *Orthosia* morphologically. Following molecular evidence for *Orthosia* and the Orthosiinae, new species were again published under this name by Stevens (2005), and the process of sorting the old American names in *Cynanchum* among molecularly supported, monophyletic genera was initiated by Liede-Schumann and Meve (2008). The present publication is intended to elucidate the structure of the subtribe Orthosiinae by adding both more taxa and more molecular markers than in Liede-Schumann et al. (2005). With this increased support, such a rigorous generic delimitation can serve as taxonomic framework for the overdue revision of the Orthosiinae.

MATERIALS AND METHODS

TAXON AND OUTGROUP SELECTION

As a starting point, the matrix of Liede-Schumann et al. (2005) was used. Outgroup samples for which *rps16* sequence data were missing were removed from the analyses. Thus, two samples of *Pentacyphus*, six of *Diplolepis*, three of *Tassadia*, seven Gonolobinae, 31 Metastelmatinae, and 37 Oxypetalinae, adding up to 86 taxa, constituted the outgroup. Following the results of Liede-Schumann et al. (2005) and Rapini et al. (2007), two samples of *Pentacyphus* were selected as the most distant outgroup. For some outgroup taxa in Metastelmatinae, different accessions were used to amplify different primer regions (Table 1), especially in cases where sequences from previous studies were available for some primers but better material had been collected in the meantime. Sequence information for these taxa was then combined to represent the species.

As ingroup, 61 samples presumably belonging to Orthosiinae were added (one accession of an undescribed genus, 12 for *Jobinia*, 33 for *Orthosia*, 15 for *Scyphostelma* Baill.). For the ingroup, we accepted only those samples with no more than one partial sequence missing, and all sequence information refers to the level of a particular accession (see Table 1).

DNA EXTRACTION, POLYMERASE CHAIN REACTION (PCR) AMPLIFICATION, AND SEQUENCING

DNA was extracted from silica-dried leaves (vouchers held at UBT) or from leaf fragments taken from herbarium specimens held at B, CORD, FR, HUEFS, MJG, MO, MSUN, NY, S, and SPF. Total DNA was extracted using the DNeasy Plant Mini Kit (Qiagen, Hilden, Germany) following the manufacturer's instructions. Several DNA samples from previous studies were also used (Liede, 2001; Liede & Meve, 2002; Liede & Täuber, 2002; Liede-Schumann et al., 2005; Silva et al., 2012). PCR primers and protocols for the plastid *trnT–trnL* and *trnL–trnF* spacers and the *trnL* intron correspond to those in Taberlet et al. (1991). The *trnL* intron and *trnL–trnF* intergenic spacer were amplified either as a single fragment using primers "c" and "f," or as two separate fragments using primer pairs "c" and "d" and "e" and "f," respectively. For purposes of alignment, the two amplified segments were kept separate, because most of the older samples had also been amplified separately. The *rps16* intron was amplified as in Liede-Schumann et al. (2005), using the primer pair rps16-1F and rps16-2R; however, amplification failed for seven ingroup samples.

An additional region, the *trnD–trnT* spacer as described by Shaw et al. (2005), was amplified for the ingroup taxa, because it provided a higher resolution than previously used markers. PCR primers followed Shaw et al. (2005), but with 94°C (3 min.) initial denaturation and 30 cycles of 93°C (1 min.), 55°C (2 min.), 72°C (3 min.), with a final phase of 72°C (5 min.). For sequencing, the primers trnE (5′-AGG ACA TCT CTC TTT CAA GGA G-3′), trnY (5′-CCG AGC TGG ATT TGA ACC A-3′), and the internal primer trnY-i (5′-CGG ATA ACT TGT TGA TTC GTC ATT C-3′), designed for American Asclepiadeae, were used.

For the ingroup, six taxa could not be amplified for the *trnD–trnT* spacer. The high variability of the *trnD–trnT* spacer, on the other hand, led to aligning problems with the more distant outgroups. Therefore, it was amplified for all except one of the Metastelmatinae, but not across the entire outgroup. The remaining outgroup taxa were therefore coded "?" for the 1592 positions of the *trnD–trnT* spacer. Furthermore, as the protocol for the amplification of the *trnD–trnT* spacer was developed during this study, the length of the 5′ end was highly variable and was found to lack approximately the first 250 bp in the older sequences. Nevertheless, all available sequence information was included in this study, following Hughes and Vogler (2004), so that as many characters as possible could be included in an analysis.

ALIGNMENT AND PHYLOGENY RECONSTRUCTIONS

For most regions, alignment was fairly straightforward, and the new sequences could be added to the existing datasets using MESQUITE (Maddison & Maddison, 2010) and alignment results were adjusted manually. For the *trnD–trnT* spacer, alignments with ClustalW2 (Chenna et al., 2003) and Muscle (Edgar, 2004), available at the European Molecular Biology Laboratory (EMBL) (<http://www.ebi.ac.uk/Tools/sequence.html>) were performed with various settings, leading to rather homogeneous blocks both in Metastelmatinae and Orthosiinae, which were then manually adjusted. The matrix has been submitted to TreeBase (<http://purl.org/phylo/treebase/phylows/study/TB2:S12128>). The best-fitting model for the five partial nucleotide datasets was selected with jModelTest version 0.1.1 (Posada, 2008); for model selection, taxa missing the particular partial sequence were removed. A set of 24 models was tested for Bayesian inference analysis (BI), and the full set of 88 models was tested for maximum likelihood analysis (ML).

BI of the combined dataset was performed with MrBayes 3.1.2 (Huelsenbeck & Ronquist, 2001), using the best models retrieved with jModeltest (see Table 2). Four runs with four Markov chains (one cold, three heated) were run for 10,000,000 generations, saving one tree every 1000 generations. Analyses were diagnosed for convergence using AWTY (Are We There Yet?) (Wilgenbusch et al., 2004). The AWTY plot of chain variability suggested a burn-in of 6000 trees before log-likelihoods were stabilized. The remaining 4000 trees from all runs (16,000 trees in total) were summarized as majority rule consensus with the percentages on the branches indicating the Bayesian posterior probabilities (PP). PP values > 95% were considered to indicate very strong support, 85%–94% strong support, 75%–84% moderate support, and < 75% poor support. Since the best model under the Akaike information criterion corrected for small datasets (AICc; Burnham & Anderson, 2003) was in some cases different from the model selected under the uncorrected Akaike information criterion or the Bayesian information criterion (BIC, Schwarz, 1978), the analysis was repeated with the other model to trace incongruencies.

ML of the nucleotide dataset was performed with GARLI 2.0 (Zwickl, 2006), which allows the use of different models for the different partitions of the dataset. The best models retrieved with jModeltest out of the 88 models available were implemented and five search replicates (searchreps = 5) were conducted. Branch support was estimated with 100 bootstrap replicates, with two search replicates for each run.

Maximum parsimony analysis (MP) was performed using Fitch parsimony as implemented in PAUP* version 4.0b10 (Swofford, 2002) using heuristic searches, with 1000 addition sequence replicates, random stepwise addition, MULTREES off, and tree-bisection-reconnection (TBR) branch swapping. The resulting trees were then used as starting trees for a second round of search with MULTREES on. The sets of equally parsimonious trees recovered from the analyses were summarized by strict consensus. To estimate branch support, a bootstrap analysis was run with 10,000 replicates, each with 10 addition sequence replicates, TBR branch swapping, MULTREES on, and MAXTREES set to 10. Bootstrap values (MP and ML) above 90% were considered to indicate very strong support, 80%–89% strong support, 70%–79% moderate support, and < 70% poor support.

RESULTS

Sequence characteristics and models selected are summarized in Table 2. BI analysis did not converge at an average standard deviation < 0.01, which indicates very good convergence, but after six million generations an average standard deviation < 0.03 was reached, which is regarded as adequate for most analyses (Ronquist et al., 2011). In the ML analysis, the best tree found by GARLI reached a score of −16771.50939. All five of the best trees retrieved display an identical topology except for the position of *Philibertia discolor* (Schltr.) Goyder in Oxypetalinae, which is placed outside *Philibertia* Kunth in one of these five trees. MP analysis yielded more than 38,300 trees (limit of computer capacity; length (L) = 864 steps, consistency index (CI) = 0.61, retention index (RI) = 0.91, rescaled consistency index (RC) = 0.56).

BI, ML, and MP analyses yielded highly congruent trees (trees summarized in Fig. 1). Bootstrap support values (BS) for ML and MP were in general lower than PP values and, for most clades, very similar to each other. The monophyly of the Orthosiinae was well supported by BI and ML analyses, but was only moderately supported by the parsimony bootstrap (70% BS, not shown). The trichotomy of Orthosiinae, *Diplolepis*, and the group composed of Metastelmatinae, *Tassadia*, Gonolobinae, and Oxypetalinae was not resolved in any analysis. *Tassadia*, Gonolobinae, and Oxypetalinae also formed a trichotomy in all analyses and were sister to Metastelmatinae. All major taxonomic groups were well supported in Bayesian and likelihood analysis, but some were only moderately supported by the parsimony bootstrap.

Clade structure in the Orthosiinae was likewise clear cut and well supported in our analyses. The new genus established herein was sister to all other Orthosiinae, a result obtained in Liede-Schumann et al. (2005) as well. *Scyphostelma* was sister to a well-supported clade composed of *Jobinia* and *Orthosia*, all well supported.

In *Jobinia*, four subclades were retrieved (Fig. 1): *J. formosa* (N. E. Br.) Liede & Meve (transferred herein) took an isolated unresolved position in this clade; one subclade comprises specimens from Ecuador and Peru (including the new *J. peruviana* Liede & Meve, and the new combinations *J. streptantha* (Malme) Liede & Meve and *J. tarmensis* (Schltr.) Liede & Meve); one subclade comprises southern Andean species (*J. umbellata* (Rusby) Liede & Meve and *J. trifurcata* (Griseb.) Liede & Meve, these consolidated as transfers to *Jobinia* herein); and one subclade comprises species from northern Argentina and Brazil (including the new combination *J. latipes* (Decne.) Liede & Meve, as well as *J. chlorantha* (K. Schum.) Malme, *J. hatschbachii* Fontella & E. A. Schwarz, and *J. lindbergii* F. Fourn.). All subclades were very well supported by all analyses. However, a sister group relationship between the "Brazilian" and the "southern Andean" subclades is only suggested by ML and remains without support. In the other analyses, the three *Jobinia* subclades remain unresolved.

While species-level resolution inside *Orthosia* and *Scyphostelma* was not the aim of the present study, and indeed was not obtained in all cases, it is noteworthy that quite often morphologically similar accessions identified to a particular species were not retrieved as a monophyletic group. This was exemplified by the 10 samples of *O. scoparia* (Nutt.) Liede & Meve, where one collection from Bolivia (*Wood 15776*) was retrieved consistently as sister to all other *Orthosia* species (Fig. 1A). Likewise, the two mainland South American samples of *O. scoparia* (*Wasum 7930* from Brazil and *van der Werff 7441* from Venezuela) were not members of the very well-supported *O. scoparia* clade, which included accessions only of Caribbean provenance.

The Argentinean and Bolivian samples (*Orthosia pearcei* (Rusby) Liede & Meve, *O. virgata* (Poir.) E. Fourn., and *Orthosia* sp. indet. a [*Liede et al. 3640*]) were strongly supported as monophyletic, even though *O. virgata* significantly diverged with a unique 10-bp insert in the *rps16* intron. This clade was sister to a clade comprising specimens of both South American and Central American origin, in which the South American samples tended to occupy positions closer to the base. In this clade, *O. kunthii*, *O. angustifolia* (Turcz.) Liede & Meve (new combination herein), and *O. pubescens* (Greenm.) Liede & Meve are represented by two accessions each, which are retrieved as monophyletic subclades. In contrast, the three accessions of *O. bonplandiana* (Schult.) Liede & Meve from Bolivia (*Wood et al. 13292*), Venezuela (*Liede & Meve 3311*), and Mexico (*Conrad 9306*) appeared in different positions of the South American–Central American clade. The Mexican accession grouped weakly with the two accessions of the Mexican *O. pubescens*, and the Bolivian accession with the two Ecuadorian accessions of *O. ellemannii* (Morillo) Liede & Meve, while the third accession took an unresolved position in the South American–Central American *Orthosia* clade. Likewise, of the three samples of *O. ellemannii* from Ecuador, only two nested in the same clade, together with an *O. bonplandiana* sample from Bolivia, while the third accession took an unresolved position in the

Table 1. Exemplar species of the Orthosiinae included in this study, with herbarium vouchers and European Molecular Biology Laboratory (EMBL) accession numbers in support of the molecular phylogeny (cf. Fig. 1). Partial sequences marked "–" were not obtained.

Species	Voucher	Country	*trnT-L*	*trnL*	*trnL-F*	*rps16*	*trnD-T*
Outgroup							
Pentacyphus andinus (Ball) Liede	*Liede & Meve 3451* (UBT)	Peru	AJ492149	AJ492150	AJ492151	AJ699335	–
Pentacyphus lehmannii (Schltr.) Liede	*Liede 3333* (cult. Bayreuth)	Ecuador	AJ290890	AJ290889	AJ290888	AJ704928	–
Diplolepis boerhaviifolia (Hook. & Arn.) Liede & Rapini	*Liede & Conrad 3062* (MSUN, ULM)	Chile	AJ428606	AJ428607	AJ428608	AJ699331	–
Diplolepis descolei (T. Mey.) Liede & Rapini	*Naumann 1347* (MB)	Argentina	AJ699301	AJ699304	AJ699302	AJ699303	–
Diplolepis geminiflora (Decne.) Liede & Rapini	*Heyne 103* (MSUN)	Chile	AJ410181	AJ410182	AJ410183	AJ699332	–
Diplolepis hieronymi (Lorentz) Liede & Rapini	*Liede & Conrad 3052* (MSUN, ULM)	Argentina	AJ410211	AJ410212	AJ410213	AJ699333	–
Diplolepis menziesii Schult.	*Liede & Conrad 3060* (K, MSUN, ULM)	Chile	AJ699274	AJ699273	AJ699275	AJ699276	–
Diplolepis nummulariifolia (Hook. & Arn.) Liede & Rapini	*Liede & Conrad 3050* (MO, MSUN, ULM)	Argentina	AJ290853	AJ290852	AJ290851	AJ699334	–
Tassadia berteroana (Spreng.) W. D. Stevens	*Nee 36277* (NY)	Bolivia	AJ428789	AJ428790	AJ428791	AJ699336	–
Tassadia guianensis Decne.	*Wolff 528* (UBT)	Ecuador	AJ699278	AJ699280	AJ699279	AJ699277	–
Tassadia obovata Decne.	*Matezki 332* (UBT)	Ecuador	AJ699282	AJ699281	AJ699283	AJ699284	–
Gonolobinae							
Gonolobus barbatus Kunth	*Conrad 9325* (UBT)	Mexico	AJ704262	AJ704261	AJ704263	AJ704264	–
Gonolobus parviflorus Decne.	*Rapini 609* (SPF)	Brazil	AJ704528	AY163689	AY163689	AJ704529	
Macroscepis hirsuta (Vahl) Schltr.	*Heyne s.n.* (UBT)	Guatemala	AJ704266	AJ704268	AJ704267	AJ704265	–
Matelea cyclophylla (Standl.) Woodson	*Barad s.n.* (UBT)	Mexico	AJ704271	AJ704269	AJ704272	AJ704273	–
Matelea gonocarpa (Walter) Shinners	*ex Wyatt s.n.* (GA)	U.S.A.	AJ704275	AJ704277	AJ704276	AJ704274	–
Matelea pedalis (E. Fourn.) Fontella & E. A. Schwarz	*Rapini 714* (SPF)	Brazil	AJ704531	AY163699	AY163699	AJ704530	
Schubertia grandiflora Mart. & Zucc.	*Liede & Conrad 3033* (MSUN, UBT, ULM)	Argentina	AJ428825	AJ428826	AJ428827	AJ699364	–
Metastelmatinae							
Barjonia chlorifolia Decne.	*Rapini 485* (SPF)	Brazil	–	AY163667	AY163667	AJ704463	–
	Rapini 1395 (SPF)	Brazil	JN701896	–	–	–	JN574510
Blepharodon glaucescens (Decne.) Fontella	*Ollerton 187* (UBT)	Guyana	AJ699290	AJ699289	AJ699291	AJ699292	HE611884
Blepharodon grandiflorum Benth.	*Liede & Meve 3318* (UBT)	Venezuela	AJ290836	AJ290837	AJ290838	AJ699337	HE611885
Blepharodon lineare (Decne.) Decne.	*Forzza 2027* (SPF)	Argentina	AJ704465	AY163668	AY163668	AJ704466	–
Blepharodon mucronatum (Schltdl.) Decne.	*Liede 3243* (UBT)	Belize	AJ290841	AJ290840	AJ290839	AJ699338	HE611886
Blepharodon pictum (Vahl) W. D. Stevens	*Rapini 938* (SPF)	Brazil	AJ704468	AY163669	AY163669	AJ704467	–
	Queiroz 9196 (HUEFS)		–	–	–	–	JN574516
Ditassa anderssonii Morillo	*Matezki SM 141* (UBT)	Ecuador	HE611702	HE611761	HE611800	HE611839	HE611887
Ditassa banksii R. Br. ex Schult.	*Konno 754* (SPF)	Brazil	AJ704474	AY163674	AY163674	AJ704473	JN574518
Ditassa burchellii Hook. & Arn.	*Krapovickas 41170* (NY)	Argentina	AJ699294	AJ699296	AJ699295	AJ699293	JN574519

Table 1. Continued.

Species	Voucher	Country	*trnT-L*	*trnL*	*trnL-F*	*rps16*	*trnD-T*
Ditassa endoleuca Schltr.	*Liede & Meve 3564* (UBT)	Ecuador	HE611703	HE611762	HE611801	HE611840	HE611888
Ditassa hispida (Vell.) Fontella	*Konno 779* (SPF)	Brazil	AJ704479	AJ704478	AJ704480	AJ704477	–
	Rapini 1431 (HUEFS)	Brazil	–	–	–	–	JN574526
Ditassa mucronata Mart.	*Arbo et al. 3885* (NY)	Brazil	AJ704270	AJ704259	AJ704278	AJ704279	–
	Rapini 1077 (HUEFS)	Brazil	–	–	–	–	JN574527
Ditassa obcordata Mart.	*Cervi 4073* (NY)	Brazil	AJ428750	AJ428751	AJ428752	AJ699340	–
	Rapini 1050 (HUEFS)	Brazil	–	–	–	–	JN574528
Ditassa retusa Mart.	*Coradin et al. 6075* (NY)	Brazil	AJ704281	AJ704283	AJ704282	AJ704280	–
	Rapini 1362 (HUEFS)	Brazil	–	–	–	–	JN574530
Ditassa tomentosa (Decne.) Fontella	*Konno 780* (SPF)	Brazil	AJ704485	AJ704484	AJ704486	AJ704483	–
	Rapini 616 (HUEFS)	Brazil	–	–	–	–	JN574531
Ditassa thymifolia (Schltr.) Liede & Meve	*Weigend et al. 8606* (B, USM)	Peru: Cajamarca	HE611735	HE611788	HE611827	HE611870	HE611929
Hemipogon acerosus Decne.	*Wood & Goyder 15689* (K)	Bolivia	AJ704289	AJ704291	AJ704290	AJ704288	–
	Rapini 1875 (HUEFS)	Brazil	–	–	–	–	JN574533
Hemipogon andinum Rusby	*Wood & Wasshausen 16626* (K)	Bolivia	AJ704293	AJ704292	AJ704294	AJ704295	HE611889
Hemipogon sprucei E. Fourn.	*Wood & Goyder 15719* (K)	Bolivia	AJ704297	AJ704299	AJ704298	AJ704296	–
	Soares e Silva 106 (HUEFS)	Brazil	–	–	–	–	JN574537
Metastelma linearifolium A. Rich.	*Urquiola et al. 561* (FR)	Cuba	AJ428807	AJ428808	AJ428809	AJ699341	JN574541
Metastelma parviflorum (Sw.) R. Br. ex Schult.	*Liede & Meve 3328* (UBT)	Venezuela	AJ428777	AJ428778	AJ428779	AJ699342	JN574543
Metastelma schaffneri A. Gray	*Liede & Conrad 2962* (UBT)	Mexico	AJ410214	AJ410215	AJ410216	AJ699343	JN574544
Minaria acerosa (Mart.) T. U. P. Konno & Rapini	*Ribas & Santos 889* (NY)	Brazil	AJ699286	AJ699288	AJ699287	AJ699285	–
	Ribeiro 183 (HUEFS)	Brazil	–	–	–	–	JN574545
Minaria decussata (Mart.) T. U. P. Konno & Rapini	*Arbo et al. 4039* (NY)	Brazil	AJ704218	AJ704220	AJ704219	AJ704217	–
	Rapini 909 (HUEFS)	Brazil	–	–	–	–	JN574546
Minaria grazielae (Fontella & Marquete) T. U. P. Konno & Rapini	*Omlor 147* (MJG)	Brazil	AJ410202	AJ410203	AJ410204	AJ699339	HE611890
Minaria magisteriana (Rapini) T. U. P. Konno & Rapini	*Rapini 597* (SPF)	Brazil	AJ704481	AY163681	AY163681	AJ704482	–
	Ribeiro 200 (HUEFS)	Brazil	–	–	–	–	JN574549
Nautonia nummularia Decne.	*Liede & Conrad 3031* (ULM)	Argentina	AJ410226	AJ 410227	AJ410228	AJ699344	HE611891
Nephradenia acerosa Decne.	*Philcox 3303* (K)	Brazil	AJ704497	AY163704	AY163705	AJ704496	–
	Soares e Silva 118 (HUEFS)		–	–	–	–	JN574551
Nephradenia asparagoides (Decne.) E. Fourn.	*Irwin 13012* (K)	Brazil	AJ704498	AY163706	AY163707	AJ704499	–
	Soares e Silva 01 (HUEFS)		–	–	–	–	JN574552

Table 1. Continued.

Species	Voucher	Country	*trnT-L*	*trnL*	*trnL-F*	*rps16*	*trnD-T*
Peplonia asteria (Vell.) Fontella & E. A. Schwarz	*Fontella sub Konno 773* (SPF)	Brazil	AJ704301	AJ704300	AJ704302	AJ704303	HE611892
Peplonia organensis (E. Fourn.) Fontella & Rapini	*Konno 854* (SPF)	Brazil	AJ704487	AY163688	AY163688	AJ704488	JN574555
Petalostelma sarcostemma (Lillo) Liede & Meve	*Liede & Conrad 3090* (MSUN, ULM)	Argentina	AJ428786	AJ428787	AJ428788	AJ699345	JN574557
Oxypetalinae							
Araujia angustifolia Steud.	*Liede & Conrad 3012* (UBT)	Argentina	AJ699290	AJ699289	AJ699291	AJ704333	–
Araujia plumosa Schltr.	*Liede & Conrad 3070* (MSUN, ULM)	Argentina	AJ704335	AJ704337	AJ704336	AJ704334	–
Araujia sericifera Brot.	*Liede & Conrad 3007* (ULM)	Argentina	AJ428792	AJ428793	AJ428794	AJ699352	–
Funastrum angustifolium (Pers.) Liede & Meve	*Liede & Conrad 3401* (UBT)	U.S.A.	AJ428759	AJ428760	AJ428761	AJ699353	–
Funastrum arenarium (Decne. ex Benth.) Liede	*Liede & Conrad 2952* (GA, ULM)	Mexico	AJ290859	AJ290858	AJ290857	AJ699354	–
Funastrum clausum (Jacq.) Schult.	*Liede & Conrad 2599* (MO, MSUN)	Mexico	AJ290860	AJ290861	AJ290862	AJ699355	–
Funastrum odoratum (Hemsl.) Schltr.	*Liede & Conrad 2560* (MO, MSUN)	Mexico	AJ290871	AJ290870	AJ290869	AJ699356	–
Morrenia odorata (Hook. & Arn.) Lindl.	*Liede & Conrad 3009* (MO, MSUN, ULM)	Argentina	AJ704343	AJ704345	AJ704344	AJ704342	–
Oxypetalum balansae Malme	*Liede & Conrad 3015* (ULM)	Argentina	AJ704347	AJ704346	AJ704348	AJ704349	–
Oxypetalum banksii Schult.	*Rapini 911* (SPF)	Brazil	AJ704503	AY163710	AY163710	AJ704502	
Oxypetalum brachystemma Malme	*Liede & Conrad 3069* (MSUN, ULM)	Argentina	AJ704351	AJ704353	AJ704352	AJ704350	–
Oxypetalum capitatum Mart.	*Mello-Silva 1923* (SPF)	Argentina	AJ704504	AY163711	AY163711	AJ704505	–
Oxypetalum coccineum Griseb.	*Galetto 562* (CORD)	Argentina	AJ704328	AJ704329	AJ704326	AJ704327	–
Oxypetalum coeruleum (D. Don ex Sweet) Decne.	*Liede & Conrad s.n.* (ULM)	Argentina	AJ704355	AJ704354	AJ704356	AJ704357	–
Oxypetalum dactylostelma Goyder	*Wood 15195* (K, UBT)	Bolivia	AJ704339	AJ704338	AJ704340	AJ704341	–
Oxypetalum lanatum Decne. ex E. Fourn.	*Rapini 929* (SPF)	Brazil	AJ704509	AJ704507	AJ704508	AJ704506	–
Oxypetalum minarum E. Fourn.	*Rapini 908* (SPF)	Brazil	AJ704510	AY163713	AY163713	AJ704511	–
Oxypetalum pannosum Decne.	*Rapini 935* (SPF)	Brazil	AJ704515	AJ704513	AJ704514	AJ704512	–
Oxypetalum pentasetum (Rusby) Goyder & Rapini	*Liede & Conrad 3128* (ULM)	Bolivia	AJ704253	AJ704252	AJ704254	AJ704255	–
Oxypetalum solanoides Hook. & Arn.	*Liede & Conrad 3004* (MO, MSUN, ULM)	Argentina	AJ704359	AJ704361	AJ704360	AJ704358	–
Oxypetalum sublanatum Malme	*Rapini 937* (SPF)	Brazil	AJ704516	AY163715	AY163715	AJ704517	–
Oxypetalum sylvestre (Hook. & Arn.) Goyder & Rapini	*Liede & Conrad 3024* (K, MO, MSUN, ULM)	Argentina	AJ410244	AJ410245	AJ410246	AJ699363	–
Oxypetalum warmingii (E. Fourn.) Fontella & Marquete	*Rapini 906* (SPF)	Brazil	AJ704521	AJ704519	AJ704520	AJ704518	–
Oxypetalum wightianum Hook. & Arn.	*Rapini 705* (SPF)	Brazil	AJ704522	AJ704524	AJ704523	AJ704525	–
Philibertia boliviana (Baill.) Goyder	*Wood et al. 15286* (K)	Bolivia	AJ704231	AJ704233	AJ704232	AJ704230	–
Philibertia candolleana (Hook. & Arn.) Goyder	*Liede & Conrad 3055* (ULM)	Argentina	AJ410175	AJ410176	AJ410177	AJ699357	–

Table 1. Continued.

Species	Voucher	Country	*trnT-L*	*trnL*	*trnL-F*	*rps16*	*trnD-T*
Philibertia discolor (Schltr.) Goyder	*Mello-Silva 1887* (SPF)	Argentina	AJ704527	AY163700	AY163700	AJ704526	–
Philibertia fontellae Goyder	*Wood & Goyder 15543* (K, UBT)	Bolivia	AJ492152	AJ492153	AJ492154	AJ699358	–
Philibertia gilliesii Hook. & Arn.	*Liede & Conrad 3054* (MO, MSUN, ULM)	Argentina	AJ290896	AJ290895	AJ290894	AJ699359	–
Philibertia globiflora Goyder	*Wood 15803* (K, UBT)	Bolivia	AJ704235	AJ704234	AJ704236	AJ704238	–
Philibertia latiflora (Griseb.) Goyder	*Liede & Conrad 3091* (MSUN, ULM)	Argentina	AJ704240	AJ704242	AJ704241	AJ704239	–
Philibertia lysimachioides (Wedd.) T. Mey.	*Liede & Conrad 3139* (MSUN, ULM)	Bolivia	AJ290902	AJ290901	AJ290900	AJ699360	–
Philibertia multiflora (T. Mey.) Goyder	*Wood & Serrano 14466* (K, UBT)	Bolivia	AJ704244	AJ704243	AJ704245	AJ704246	–
Philibertia parviflora (Malme) Goyder	*Liede & Conrad 3113* (UBT)	Argentina	AJ410223	AJ410224	AJ410225	AJ699361	–
Philibertia peduncularis (Benth.) Goyder	*Wood & Goyder 15444* (K, UBT)	Bolivia	AJ704249	AJ704251	AJ704250	AJ704247	–
Philibertia picta Schltr.	*Liede & Conrad 3104* (K, MO, MSUN, ULM)	Argentina	AJ290903	AJ290904	AJ290905	AJ699362	–
Tweedia brunonis Hook. & Arn.	*Liede & Conrad 3058* (UBT)	Argentina	AJ704257	AJ704260	AJ704258	AJ704256	–
Ingroup							
Jobinia chlorantha (K. Schum.) Malme	*Wolff 110* (UBT)	Ecuador: Zamora-Chinchipe	HE611704	HE611751	HE611751	HE611842	HE611893
Jobinia formosa (N. E. Br.) Liede & Meve	*Liede & Conrad 3061* (MSUN)	Chile: Coquimbo	AJ428639	AJ428640	AJ428641	AJ699346	HE611900
Jobinia hatschbachii Fontella & E. A. Schwarz	*Konno 856* (SP)	Brazil: São Paulo	HE611705	HE611763	HE611802	HE611842	HE611894
Jobinia latipes (Decne.) Liede & Meve	*Tressens et al. 6647* (CTES, UBT)	Argentina: Misiones	HE611706	HE611764	HE611803	HE611843	HE611895
Jobinia lindbergii E. Fourn.	*Farinaccio 194* (SPF)	Brazil	AJ704491	AY163694	AY163694	AJ704490	–
Jobinia peruviana Liede & Meve	*Hutchinson & Wright 5439* (S)	Peru: Cajamarca	HE611707	HE611765	HE611804	HE611844	HE611896
Jobinia streptantha (Malme) Liede & Meve	*Liede & Meve 3550* (UBT)	Ecuador: Bolivar	HE611708	HE611766	HE611805	HE611845	HE611897
Jobinia tarmensis (Schltr.) Liede & Meve	*Tupayachi & Galiano 761* (NY)	Peru: Cuzco	AJ428744	AJ428745	AJ428746	AJ699349	–
Jobinia trifurcata (Griseb.) Liede & Meve	*Liede-Schumann et al. 3636* (CORD)	Argentina: La Rioja	HE611709	HE611752	HE611752	HE611846	HE611898
Jobinia trifurcata (Griseb.) Liede & Meve	*Wood et al. 15308* (K, UBT)	Bolivia: Chuquisaca	HE611710	HE611753	HE611753	HE611847	HE611899
Jobinia umbellata (Rusby) Liede & Meve	*Goyder sub Wood 15798* (K, UBT)	Bolivia: La Paz	AJ704317	AJ704316	AJ704318	AJ704319	HE611902
Jobinia sp. indet.	*Wood & Goyder 15578* (K, UBT)	Bolivia: Santa Cruz	AJ704313	AJ704315	AJ704314	AJ704312	HE611901
Monsanima morrenioides (Goyder) Liede & Meve	*Omlor 160* (MJG)	Brazil: Bahia	AJ428684	AJ428685	AJ428686	AJ699348	HE611903
Orthosia angustifolia (Turcz.) Liede & Meve	*Nee 33059* (NY)	Mexico: Veracruz	HE611711	HE611767	HE611806	HE611848	HE611904
Orthosia angustifolia (Turcz.) Liede & Meve	*Reyes A-5219* (XAL)	Mexico: Veracruz	HE611712	HE611754	HE611754	HE611849	HE611905
Orthosia bonplandiana (Schult.) Liede & Meve	*Conrad 9306* (UBT)	Mexico: Michoacan	HE611713	HE611768	HE611807	HE611849	HE611906
Orthosia bonplandiana (Schult.) Liede & Meve	*Liede & Meve 3311* (UBT)	Venezuela: Mérida	HE611714	HE611769	HE611808	HE611851	HE611907
Orthosia bonplandiana (Schult.) Liede & Meve	*Wood et al. 13292* (K)	Bolivia: Chuquisaca	HE611715	HE611770	HE611809	HE611909	HE611908
Orthosia calycina (Schltr.) Liede & Meve	*Weigend et al. 7530* (B)	Peru: Cajamarca	HE611716	HE611755	HE611755	HE611853	HE611909
Orthosia congesta (Vell.) Decne.	*Konno 855* (SP)	Brazil: Rio de Janeiro	HE611717	HE611771	HE611810	HE611854	HE611910
Orthosia ellemannii (Morillo) Liede & Meve	*Liede & Meve 3457* (UBT)	Ecuador: Loja	AJ428780	AJ428781	AJ428782	AJ699350	HE611918
Orthosia ellemannii (Morillo) Liede & Meve	*Liede & Meve 3487* (ex hort.)	Ecuador: Carchi	HE611718	HE611772	HE611811	HE611855	HE611911

Table 1. Continued.

Species	Voucher	Country	*trnT-L*	*trnL*	*trnL-F*	*rps16*	*trnD-T*
Orthosia ellemannii (Morillo) Liede & Meve	*Matezki 161* (UBT)	Ecuador: Loja	HE611719	HE611773	HE611812	HE611856	HE611912
Orthosia kunthii Decne.	*Hinton et al. 24347* (NY)	Mexico: Nuevo Léon	AJ428783	AJ428784	AJ428785	AJ699351	HE611919
Orthosia kunthii Decne.	*Valdés et al. 1961* (NY)	Mexico: Nuevo Léon	HE611720	HE611774	HE611813	HE611857	HE611913
Orthosia meridensis (Morillo) Liede & Meve	*Liede & Meve 3310* (UBT)	Venezuela: Barinas	HE611721	HE611775	HE611814	HE611858	HE611914
Orthosia pearcei (Rusby) Liede & Meve	*Galetto 723* (CORD, NY)	Argentina: Cordóba	HE611722	HE611776	HE611815	HE611859	HE611915
Orthosia pearcei (Rusby) Liede & Meve	*Wood 10514* (K, UBT)	Bolivia: Cochabamba	HE611723	HE611777	HE611816	–	HE611916
Orthosia pubescens (Greenm.) Liede & Meve	*Prinzie et al. 207* (TEX)	Mexico: México	HE611724	HE611778	HE611817	HE611860	HE611917
Orthosia pubescens (Greenm.) Liede & Meve	*Ventura 555* (NY)	Mexico: México	HE611725	HE611779	HE611818	HE611861	–
Orthosia scoparia (Nutt.) Liede & Meve	*Acevedo et al. 7714* (NY)	Puerto Rico	AJ704320	AJ704322	AJ704321	–	HE611920
Orthosia scoparia (Nutt.) Liede & Meve	*Axelrod 8409* (NY)	Puerto Rico	HE611726	HE611780	HE611819	HE611862	HE611921
Orthosia scoparia (Nutt.) Liede & Meve	*Easley 542* (NY)	U.S.A.: Florida	HE611727	HE611781	HE611820	HE611863	HE611922
Orthosia scoparia (Nutt.) Liede & Meve	*Mangelsdorff RMC 246* (UBT)	Cuba: Guantanamo	HE611728	HE611782	HE611821	HE611864	HE611923
Orthosia scoparia (Nutt.) Liede & Meve	*Mangelsdorff RMC 3125* (FR)	Cuba: Cienfuegos	HE611729	HE611783	HE611822	HE611865	HE611924
Orthosia scoparia (Nutt.) Liede & Meve	*van der Werff & Wingfield 7441* (NY)	Venezuela: Falcón	HE611730	HE611784	HE611823	HE611866	–
Orthosia scoparia (Nutt.) Liede & Meve	*Wasum et al. 7930* (NY)	Brazil: Rio Grande do Sul	HE611731	HE611785	HE611824	HE611867	HE611925
Orthosia scoparia (Nutt.) Liede & Meve	*Wood & Goyder 15776* (K, UBT)	Bolivia: Santa Cruz	HE611732	HE611786	HE611825	HE611868	HE611926
Orthosia scoparia (Nutt.) Liede & Meve	*Mika et al. 072* (FR)	Dominican Republic: La Vega	HE611733	HE611756	HE611756	HE611869	HE611927
Orthosia scoparia (Nutt.) Liede & Meve	*Mika et al. 073* (FR)	Dominican Republic: La Vega	HE611734	HE611787	HE611826	–	HE611928
Orthosia urceolata E. Fourn.	*Carrião 27500* (NY)	Brazil: Paraná	AJ704324	AJ704323	AJ704325	–	HE611934
Orthosia virgata (Poir.) E. Fourn.	*Morero 112* (CORD)	Argentina: Córdoba	HE611736	HE611757	HE611757	HE611871	HE611930
Orthosia woodii Meve & Liede	*Wood 10369* (K)	Bolivia: Chuquisaca	HE611737	HE611789	HE611828	HE611872	HE611931
Orthosia sp. indet. a	*Liede et al. 3640* (CORD)	Argentina: Catamarca	HE611738	HE611758	HE611758	–	HE611932
Orthosia sp. indet. b	*Wood 15994* (K, UBT)	Bolivia: Cochabamba	HE611739	HE611759	HE611759	–	HE611933
Scyphostelma beckii (Morillo) Liede & Meve	*Liede & Conrad 3141* (MSUN, ULM)	Bolivia: La Paz	AJ704305	AJ704307	AJ704306	AJ704304	–
Scyphostelma bifida (Liede & Meve) Liede & Meve	*Liede & Meve 3557* (UBT)	Ecuador: Azuay	HE611740	HE611790	HE611829	HE611873	HE611935
Scyphostelma ecuadorensis (Schltr.) Liede & Meve	*Liede & Meve 3556* (UBT)	Ecuador: Chimborazo	HE611748	HE611797	HE611836	HE611880	HE611943
Scyphostelma ecuadorensis (Schltr.) Liede & Meve	*Harling & Ståhl 26512* (S)	Ecuador: Loja	HE611741	HE611791	HE611830	HE611874	HE611936
Scyphostelma harlingii (Morillo) Liede & Meve	*Liede & Meve 3460* (UBT)	Ecuador: Zamora-Chinchipe	AJ704309	AJ704308	AJ704310	AJ704311	HE611946
Scyphostelma lechleri (Morillo) Liede & Meve	*Liede & Conrad 3136* (MSUN, ULM)	Bolivia: La Paz	AJ428753	AJ428754	AJ428755	HE611883	HE611947

Table 1. Continued.

Species	Voucher	Country	*trnT-L*	*trnL*	*trnL-F*	*rps16*	*trnD-T*
Scyphostelma microphylla (Kunth) Liede & Meve	*Cerón & Alcarón 12217* (MO)	Ecuador: Pichincha	AJ428681	AJ428682	AJ428683	AJ699347	–
Scyphostelma velutina (Morillo) Liede & Meve	*Liede & Meve 3555* (UBT)	Ecuador: Chimborazo	HE611747	HE611796	HE611835	HE611879	HE611942
Scyphostelma wurdackii (Morillo) Liede & Meve	*Liede 3342* (UBT)	Ecuador: Cuenca	HE611743	HE611793	HE611832	–	HE611938
Scyphostelma sp. indet. a	*Liede & Meve 3473* (UBT)	Ecuador: Pichincha	HE611744	HE611794	HE611833	HE611876	HE611939
Scyphostelma sp. indet. b	*Liede & Meve 3474* (UBT)	Ecuador: Pichincha	HE611745	HE611760	HE611760	HE611877	HE611940
Scyphostelma sp. indet. c	*Liede & Meve 3552* (UBT)	Ecuador: Bolívar	HE611746	HE611795	HE611834	HE611878	HE611941
Scyphostelma sp. indet. d	*Liede & Meve 3563* (UBT)	Ecuador: Loja	HE611749	HE611798	HE611837	HE611881	HE611944
Scyphostelma sp. indet. e	*Wood 10297* (K, UBT)	Bolivia: Cochabamba	HE611750	HE611799	HE611838	HE611882	HE611945
Scyphostelma sp. indet. f	*Weigend et al. 5821* (B)	Peru: Cajamarca	HE611742	HE611792	HE611831	HE611875	HE611937

South American–Central American *Orthosia* clade. These results show that neither the sampling density nor the amount of data created is yet sufficient for a species-level phylogeny of *Orthosia*. In particular, the widespread and frequent species (*O. scoparia*, *O. bonplandiana*, and, to a lesser extent, *O. ellemannii*) seem to be composed of morphologically indistinguishable but polyphyletic elements, which are more closely related to morphologically well-characterized but much more narrowly distributed species.

Clade structure in *Scyphostelma* was also difficult to reconcile to either morphological characters or geographical distributions (Fig. 1A). Three unresolved subclades were found, the first comprising *S. beckii* (Morillo) Liede & Meve (new combination herein) (*Liede & Conrad 3141*) and *Scyphostelma* sp. indet. f (*Weigend 5821*), the second comprising *S. harlingii* (Morillo) Liede & Meve (new combination herein) (*Liede & Meve 3460*) and *Scyphostelma* sp. indet. e (*Wood 10297*), and the third comprising the remainder of the *Scyphostelma* species. Only the subclade of *S. harlingii* and *Scyphostelma* sp. indet. e (*Wood 10297*) is morphologically distinct, e.g., lacking the characteristic long shoot–short shoot architecture of *Scyphostelma*.

Taxonomic Treatment

As supported by the molecular evidence presented here, the division of the Orthosiinae into three, and now a fourth and newly described, genera is warranted. These four genera, *Jobinia*, *Monsanima*, *Orthosia*, and *Scyphostelma*, are restricted to the New World and accommodate most of the diversity of former *Cynanchum* sensu Woodson (1941). All four genera are highly similar to Old World *Cynanchum*, but none of the described taxa are known to have prophylls, which therefore constitutes a synapomorphy for *Cynanchum* s. str. (as "stipules" in Liede & Täuber, 2002). In the Americas, *Cynanchum* is represented only by *Cynanchum* subg. *Mellichampia* (A. Gray) Sundell as circumscribed by Sundell (1981), which is characterized by cordate leaf bases, racemose inflorescences, and ovoid, often rather thick-walled fruits. Morphologically, the four genera of Orthosiinae remain difficult to distinguish, and the key presented here can only be used as a rough guide to the taxonomic boundaries. For a list of species names treated in this paper, see Appendix 1.

Key to the Genera of Orthosiinae

1a. Leaf blades usually not linear, but ovate or cordate, often with an extended tip, usually longer than 5 cm; inflorescences usually as long or longer than the leaves; mericarps 2, usually 5

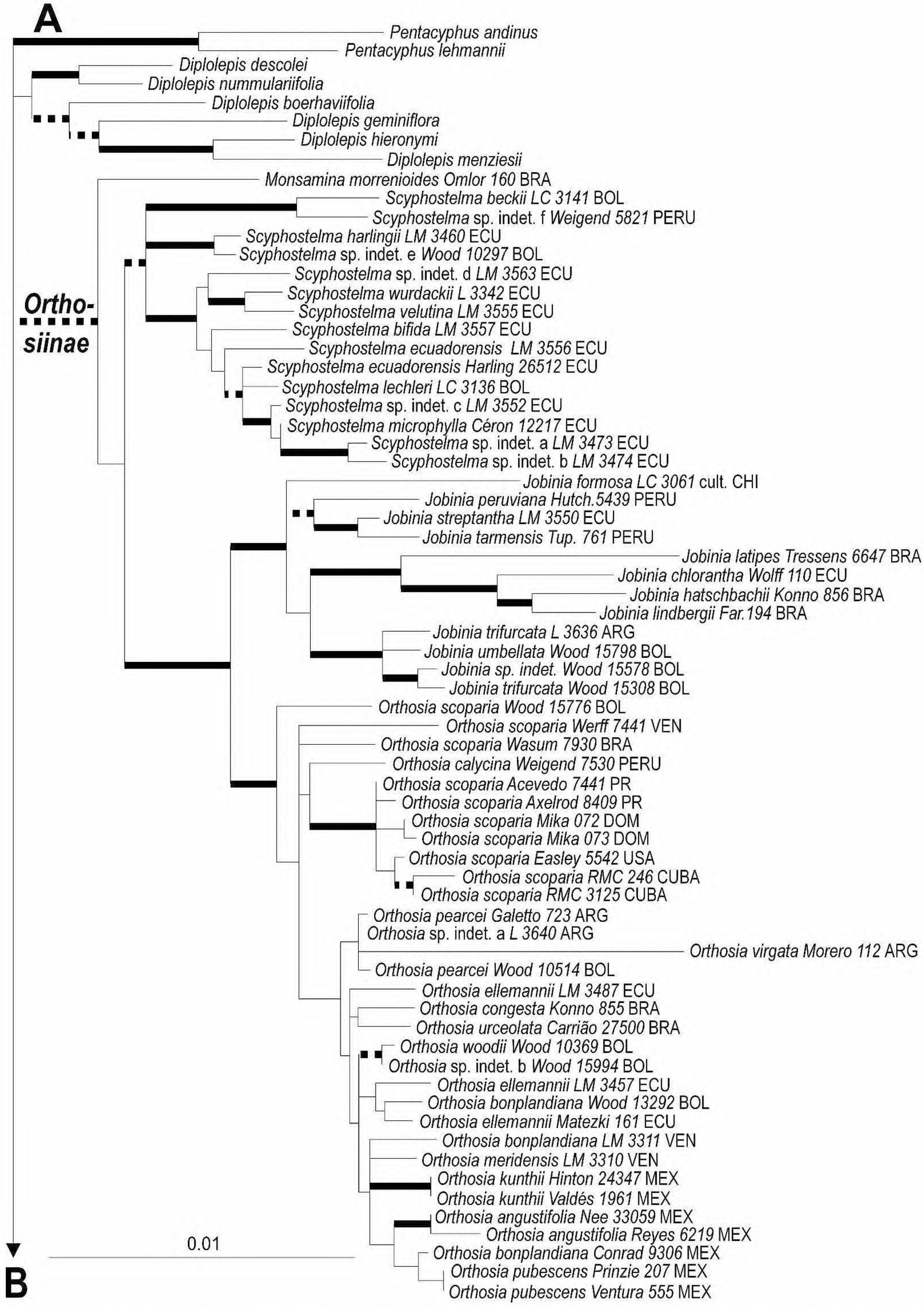

A
Pentacyphus andinus
Pentacyphus lehmannii
Diplolepis descolei
Diplolepis nummulariifolia
Diplolepis boerhaviifolia
Diplolepis geminiflora
Diplolepis hieronymi
Diplolepis menziesii
Monsamina morrenioides Omlor 160 BRA
Scyphostelma beckii LC 3141 BOL
Scyphostelma sp. indet. f Weigend 5821 PERU
Scyphostelma harlingii LM 3460 ECU
Scyphostelma sp. indet. e Wood 10297 BOL
Scyphostelma sp. indet. d LM 3563 ECU
Scyphostelma wurdackii L 3342 ECU
Scyphostelma velutina LM 3555 ECU
Scyphostelma bifida LM 3557 ECU
Scyphostelma ecuadorensis LM 3556 ECU
Scyphostelma ecuadorensis Harling 26512 ECU
Scyphostelma lechleri LC 3136 BOL
Scyphostelma sp. indet. c LM 3552 ECU
Scyphostelma microphylla Céron 12217 ECU
Scyphostelma sp. indet. a LM 3473 ECU
Scyphostelma sp. indet. b LM 3474 ECU
Ortho-
siinae
Jobinia formosa LC 3061 cult. CHI
Jobinia peruviana Hutch.5439 PERU
Jobinia streptantha LM 3550 ECU
Jobinia tarmensis Tup. 761 PERU
Jobinia latipes Tressens 6647 BRA
Jobinia chlorantha Wolff 110 ECU
Jobinia hatschbachii Konno 856 BRA
Jobinia lindbergii Far.194 BRA
Jobinia trifurcata L 3636 ARG
Jobinia umbellata Wood 15798 BOL
Jobinia sp. indet. Wood 15578 BOL
Jobinia trifurcata Wood 15308 BOL
Orthosia scoparia Wood 15776 BOL
Orthosia scoparia Werff 7441 VEN
Orthosia scoparia Wasum 7930 BRA
Orthosia calycina Weigend 7530 PERU
Orthosia scoparia Acevedo 7441 PR
Orthosia scoparia Axelrod 8409 PR
Orthosia scoparia Mika 072 DOM
Orthosia scoparia Mika 073 DOM
Orthosia scoparia Easley 5542 USA
Orthosia scoparia RMC 246 CUBA
Orthosia scoparia RMC 3125 CUBA
Orthosia pearcei Galetto 723 ARG
Orthosia sp. indet. a L 3640 ARG
Orthosia virgata Morero 112 ARG
Orthosia pearcei Wood 10514 BOL
Orthosia ellemannii LM 3487 ECU
Orthosia congesta Konno 855 BRA
Orthosia urceolata Carrião 27500 BRA
Orthosia woodii Wood 10369 BOL
Orthosia sp. indet. b Wood 15994 BOL
Orthosia ellemannii LM 3457 ECU
Orthosia bonplandiana Wood 13292 BOL
Orthosia ellemannii Matezki 161 ECU
Orthosia bonplandiana LM 3311 VEN
Orthosia meridensis LM 3310 VEN
Orthosia kunthii Hinton 24347 MEX
Orthosia kunthii Valdés 1961 MEX
Orthosia angustifolia Nee 33059 MEX
Orthosia angustifolia Reyes 6219 MEX
Orthosia bonplandiana Conrad 9306 MEX
Orthosia pubescens Prinzie 207 MEX
Orthosia pubescens Ventura 555 MEX
0.01
B

Figure 1. Tree resulting from maximum likelihood analysis (ML) of the combined dataset. Branches drawn as thick lines indicate BS values > 90% (MP and ML) and PP > 0.95 (BI); branches drawn as thick dotted lines indicate BS values 80%–89% (MP and ML) and PP > 0.95 (BI). —A. Relationships of the ingroup taxa; accessions and geographical origin indicated (see Table 1). ARG: Argentina; BOL: Bolivia; BRA: Brazil; cult. CHI: cultivated in Chile; DOM: Dominican Republic; ECU: Ecuador; MEX: Mexico; PR: Puerto Rico; VEN: Venezuela. Abbreviations of collectors used: Far.: Farinaccio; Hutch.: Hutchinson & Wright; L: Liede; LC: Liede & Conrad; LM: Liede & Meve; RMC: Mangelsdorff; Tup.: Tupayachi & Galiano (see Table 1).

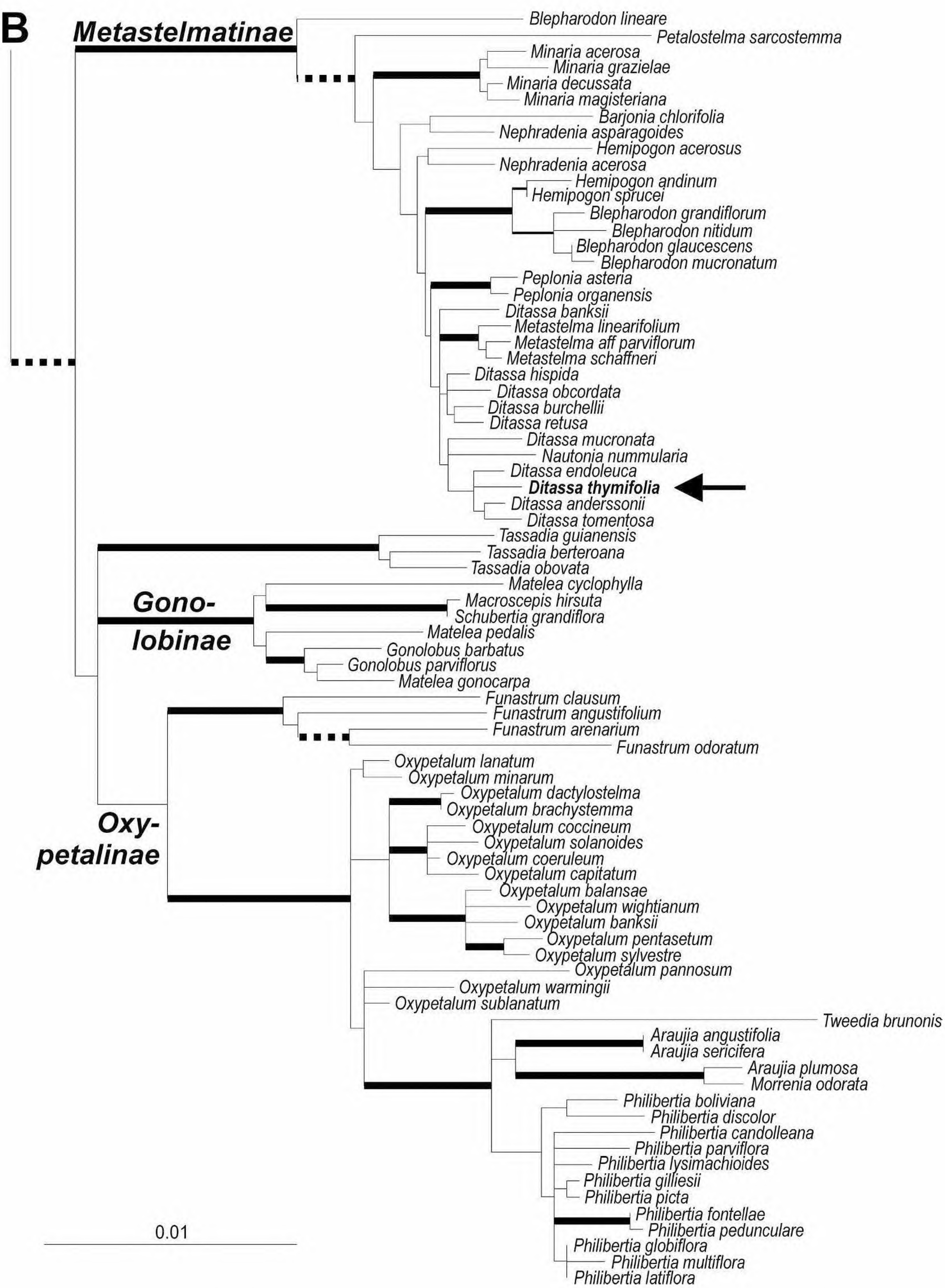


Figure 1. Continued.—B. Relationships of the outgroup taxa; partial sequences used for a species may have been produced from different accessions (see Table 1). The position of *Ditassa thymifolia* (Schltr.) Liede & Meve is indicated with an arrow.

Table 2. Sequence characteristics and models for phylogenetic analysis. Number of sequences newly reported here. The *trnD-T* spacer sequence was not analyzed across the first 250 base pairs, which were incomplete for several accessions. For several taxa, the first 243 bp of the *trnD-T* spacer were missing; for *Nephradenia asparagoides* (Decne.) E. Fourn. and *Orthosia scoparia* (Nutt.) Liede & Meve, accession *RMC 246*, 367 bp and 474 bp, respectively, were missing.

	trnT-L intergenic spacer	*trnL* intron	*trnL-F* intergenic spacer	*rps16* intron	*trnD-T* intergenic spacer
Length (bp)	747–1027	456–547	197–387	738–849	914–1321 (989–1184)
Aligned length (bp)	1235	587	443	927	1592
New sequences	49	49	49	45	64
Missing partial sequences	0	0	0	6	63
Missing data (% total)	0.2	0.3	0.7	4.7	total: 47.6; ingroup: 20.9
Missing data (% in available partial sequences)	0.2	0.3	0.7	0.6	9.3
Variable characters	272	87	100	232	252
Parsimony informative characters	119	38	44	114	108
Best-fit model of nucleotide substitution (24 models tested)	GTR	GTR+G (AIC, BIC); HKY+G (AICc)	GTR+G (AIC, BIC); F81+G (AICc)	GTR+G	HKY+I+G (AIC, AICc) F81+I+G (BIC)
Best-fit model of nucleotide substitution (88 models tested)	TVM+G	trN+G	TIM1+G (AIC, BIC); F81+G (AICc)	TVM+G	HKY+I+G (AIC, AICc) F81+I+G (BIC)

Abbreviations: AIC: Akaike information criterion; AICc: Akaike information criterion corrected for small datasets; BIC: Bayesian information criterion; F81: Felsenstein (1981); GTR: general time reversible model (Tavaré, 1986); HKY: Hasegawa-Kishino-Yano (1985); TIM: transitional model: $rAC = rGT \neq rAT = rCG \neq rAG \neq rGT$; TrN: Tamura & Nei (1993); TVM: transversional model: $rAC = rCT \neq rAG \neq rAT \neq rCG \neq rGT$; +G: shape parameter of the gamma distribution accounting for substitution rate heterogeneity; +I: proportion of invariant sites.

cm or longer, at acute angles, occasionally remaining fused at the tips .... I. *Jobinia*

1b. Leaf blades linear to lanceolate, if other shapes, then distinctly shorter than 5 cm; inflorescences usually shorter than the leaves; mericarps 1 or 2, usually < 5 cm long, at various angles, but never fused at the tips 2

2a. Anther wings not extending the entire length of the anther, basally strongly centrifugal; corona united into a tube obscuring the gynostegium; tube folded inward apically .... II. *Monsanima*, new genus

2b. Anther wings usually extending the entire length of the anther, never strongly centrifugal basally; corona either not united into a tube obscuring the gynostegium, or, if so, then the tube not folded inward apically 3

3a. Inflorescences often axillary or almost so, stems green, long and short shoots not conspicuously distinct, often leafless at flowering time; mericarps always in pairs at obtuse angles, ± cylindrical without distinct beak .... III. *Orthosia*

3b. Inflorescences usually not axillary, stems usually soon turning brown, long and short shoots usually conspicuously distinct, if indistinct, then stems not green; leaves occasionally not linear, but rarely longer than 2 cm (those on short shoots always shorter); mericarps single or paired, at various angles, distinctly fusiform or spindle-shaped and often beaked .... IV. *Scyphostelma*

ORTHOSIINAE

I. Jobinia E. Fourn., Flora Brasiliensis 6(4): 327, pl. 97. 1885. TYPE: *Jobinia hernandiifolia* (Decne.) E. Fourn.

Cyathostelma E. Fourn., Flora Brasiliensis 6(4): 219. 1885, syn. nov. TYPE: *Cyathostelma latipes* (Decne.) E. Fourn. [≡ *Metastelma latipes* Decne., ≡ *Jobinia latipes* (Decne.) Liede & Meve].

Dicarpophora Speg., Physis (Buenos Aires) 8: 269. 1926, syn. nov. TYPE: *Dicarpophora mazzuchii* Speg. [≡ *Cynanchum mazzuchii* (Speg.) Liede].

Jobinia was established by Fournier (1885) with two species from Brazil, the generitype *J. hernandiifolia* (Decne.) E. Fourn. and *J. lindbergii*. The extended key of Fontella Pereira and Schwarz (1982) would later recognize an additional three species in Brazil: *J. hatschbachii*, *J. lutziae* Fontella & E. A. Schwarz, and *J. paranaensis* Fontella & C. Valente. In their treatment (Fontella Pereira & Schwarz, 1982), *J. hernandiifolia* was transferred to synonymy of *J. connivens* (Hook. & Arn.) Malme, and *J. furcata* (E. Fourn.) Fontella as a synonym to *J. lindbergii*. One species from Ecuador and Bolivia, *J. chlorantha*, is listed but not further treated. To these six species, Stevens (2000) added two from Ecuador, *J. balslevii* (Morillo) W. D. Stevens (Fig. 2) and *J. campii* (Morillo) W. D. Stevens, and one more, *J. eulaxiflora* (Lundell) W. D. Stevens, from Guatemala in Central America. Liede and Meve (2001) further described a Venezuelan taxon, *J. neei* (Morillo) Liede & Meve, as well as one from Argentina, *J. glossostemma* (Lillo) Liede & Meve. Fontella Pereira and Britto de Goes (2007) subsumed *J. lutziae* under *J. grandis* (Hand.-Mazz.) Goes & Fontella, resolving the issue of an unusually large-flowered *Orthosia*, and described one more Brazilian species, *J. longicoronata* Goes & Fontella, which brought the recognized generic total to 12 species, of which six are from Brazil. Two of these established taxa, *J. hatschbachii* and *J. lindbergii*, were represented in the phylogenetic analysis by Brazilian accessions, and both are well embedded within the larger *Jobinia* clade, affined to a *J. chlorantha* accession from Zamora-Chinchipe, Ecuador.

Herein, 13 more species are added to the genus, 12 of which are transferred from *Cynanchum*. One species, *Jobinia peruviana*, is new to science, and is highly atypical for *Jobinia*, with its erect habit, linear leaves, and depauperate inflorescences. However, the molecular analysis is unambiguous as to the position of this species within *Jobinia*. Of the 25 species of the genus, eight now come from Brazil, whereas 13 are found in the high Andes of Ecuador, Peru, and Bolivia. Especially in Bolivia, more species might await description following a more detailed study, as the one unnamed collection included in the molecular study (*Wood 15578*) indicates. The range of two species extends south into Argentina, one north to Venezuela, and one more reaches Central America in Guatemala. Most of the species are rare in their distributions and occur in very small populations; often only a single individual is found over a quite large distance (Liede-Schumann & Meve, pers. obs.).

The inclusion of *Dicarpophora*, which was lectotypified by Liede (1997), is based on the figure from Spegazzini's 1926 protologue, because all attempts to trace material from Spegazzini failed. The plant depicted, however, shows the often heart-shaped leaves; the richly branched, loose inflorescences (e.g., *Jobinia balslevii*, Fig. 2); and the long, almost parallel fruits of *Jobinia* (e.g., *J. canoi* (Morillo) Liede & Meve, Fig. 3). However, it cannot be ascertained whether another similar one of the recognized *Jobinia* species is depicted, and Spegazzini's statement that it was sent to him from a garden in Tupiza (Bolivia) likewise gives no useful hint to its identity. Therefore, it seems prudent to continue to recognize *J. mazzuchii* (Speg.) Liede & Meve as a separate species. Additionally, with the inclusion of both species of *Cyathostelma*, *C. furcatum* E. Fourn. and *C. latipes*

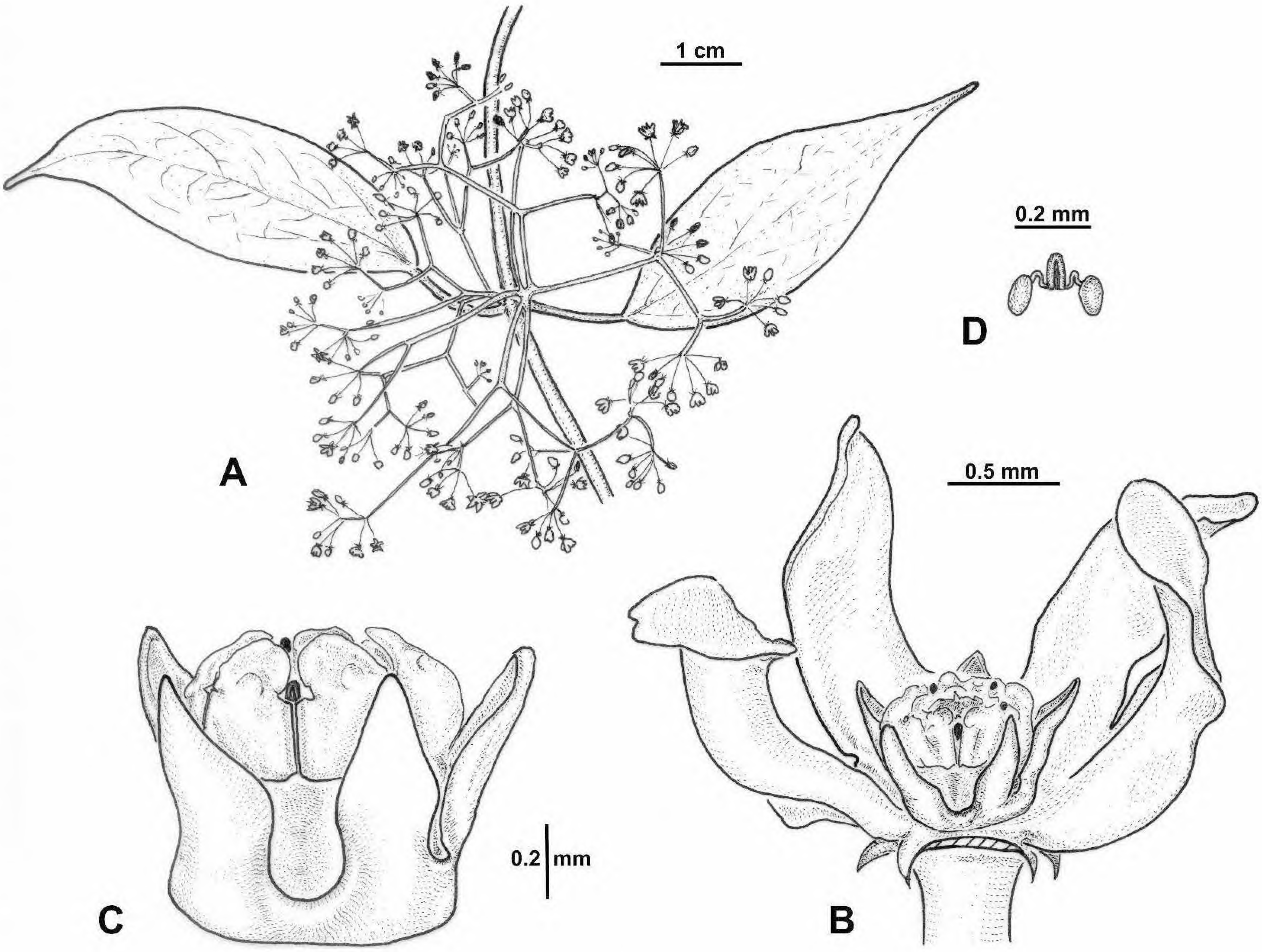


Figure 2. *Jobinia balslevii* (Morillo) W. D. Stevens. —A. Inflorescence. —B. Flower, lateral view. —C. Gynostegium and corona. —D. Pollinarium. A–D from isotype *Balslev 10415* (NY). Drawn by U. Meve.

(Decne.) E. Fourn., in *Jobinia*, no component species remain for the genus *Cyathostelma* sensu Fournier (1885).

Included species. The 25 taxa of *Jobinia* are listed here; those included in the molecular analysis are indicated in boldface. *J. balslevii* (Morillo) W. D. Stevens, *J. campii* (Morillo) W. D. Stevens, *J. canoi* (Morillo) Liede & Meve [≡ *Cynanchum canoi* Morillo], ***J. chlorantha*** (K. Schum.) Malme, *J. connivens* (Hook. & Arn.) Malme, *J. eulaxiflora* (Lundell) W. D. Stevens, *J. fontellana* Liede & Meve [≡ *Orthosia hatschbachii* Fontella & Goes], ***J. formosa*** (N. E. Br.) Liede & Meve [≡ *C. formosum* N. E. Br.], *J. glossostemma* (Lillo) Liede & Meve, *J. grandis* (Hand.-Mazz.) Goes & Fontella, ***J. hatschbachii*** Fontella & E. A. Schwarz, ***J. latipes*** (Decne.) Liede & Meve [≡ *Metastelma latipes* Decne.], ***J. lindbergii*** E. Fourn., *J. longicoronata* Goes & Fontella, *J. mazzuchii* (Speg.) Liede & Meve [≡ *Dicarpophora mazzuchii* Speg.], *J. neei* (Morillo) Liede & Meve, *J. paranaensis* Fontella & C. Valente, ***J. peruviana*** Liede & Meve, *J. samuelssonii* (Malme) Liede & Meve [≡ *C. samuelssonii* Malme], *J. schizocorona* (Liede & Meve) Liede & Meve [≡ *C. schizocoronum* Liede & Meve], ***J. streptantha*** (Malme) Liede & Meve [≡ *C. streptanthum* Malme], ***J. tarmensis*** (Schltr.) Liede & Meve [≡ *C. tarmense* Schltr.], *J. tiarata* (Malme) Liede & Meve [≡ *C. tiaratum* Malme], ***J. trifurcata*** (Griseb.) Liede & Meve [≡ *Metastelma trifurcatum* Griseb.], ***J. umbellata*** (Rusby) Liede & Meve [≡ *Vincetoxicum umbellatum* Rusby].

1. Jobinia canoi (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum canoi* Morillo, Ernstia 4: 4. 1994. TYPE: Peru. Cusco: Paucartambo, Acjanaco, Parque Nac. Manú, Trocha Ericsson, 3350–3400 m, 27 Mar. 1992, *A. Cano E. 5365* (holotype, USM!; isotype, MERF!). Figure 3.

Morphological evidence clearly points to *Jobinia* for generic affiliation of *Cynanchum canoi*. First of all the species possesses a highly significant and key character of *Jobinia*, the fusiform and parallel to sparsely spreading two mericarps, whereas in *Scyphostelma* and *Cynanchum* only single mericarps are formed. In *Orthosia*, two mericarps are also the rule; however, these are narrowly oblong, spreading, and smooth (and also never longitudinally grooved as in parts of *Jobinia*, including *J. canoi*, Fig. 3F). Vegetatively, *J. canoi* is hard to distinguish, e.g., from *J. chlorantha* or *J. hatschbachii*, with its glabrous (or nearly so) leaves of smooth and thin texture. Rostrate style heads are found in quite a number of *Jobinia* species, e.g., *J. peruviana* (Fig. 4)

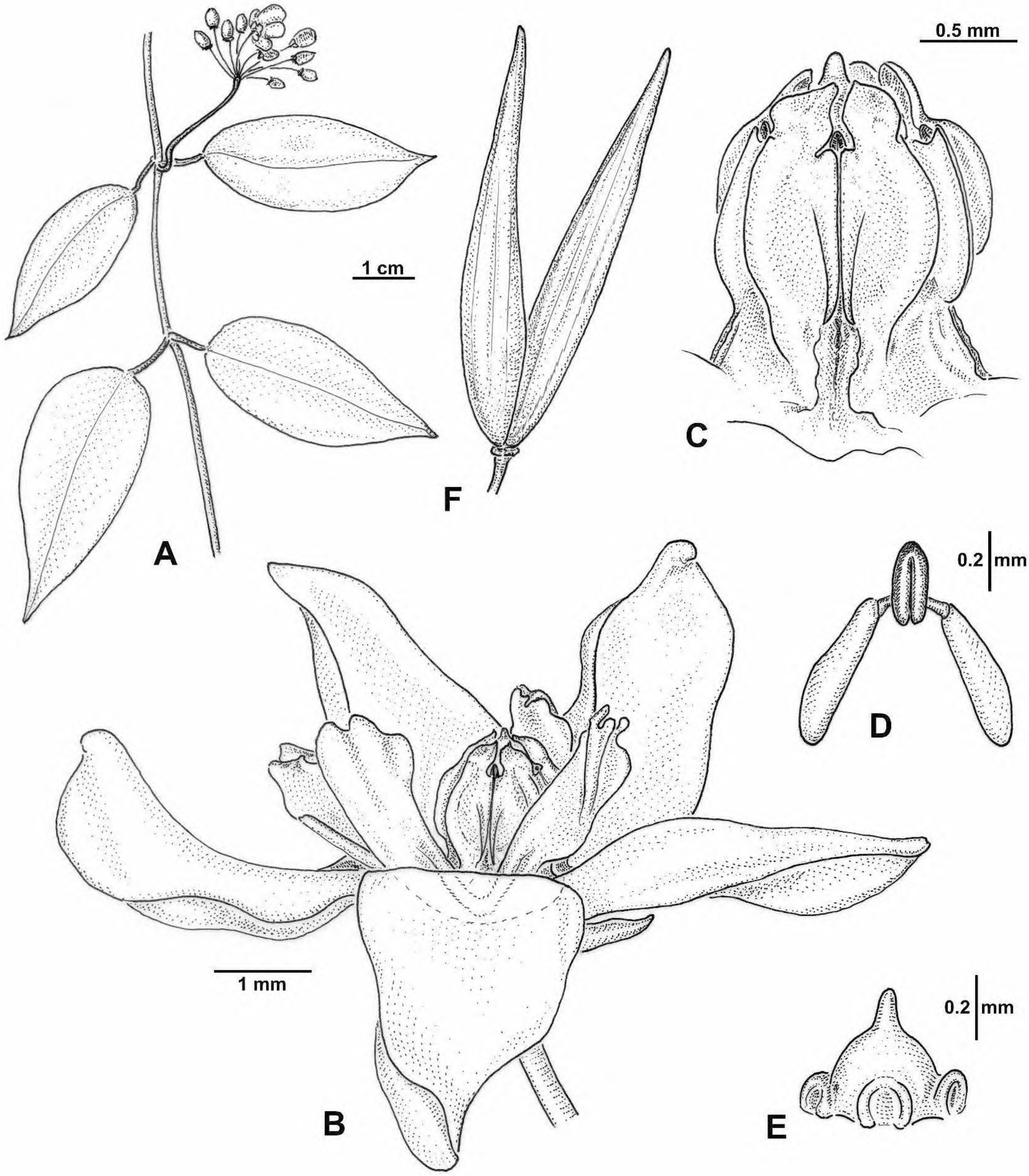


Figure 3. *Jobinia canoi* (Morillo) Liede & Meve. —A. Branch with inflorescence. —B. Flower, lateral view. —C. Gynostegium. —D. Pollinarium. —E. Style head. —F. Twin mericarps. A–F from *Herrera 2086* (S). Drawn by U. Meve.

or *J. streptantha*, but this feature is not known from New World *Cynanchum* or *Orthosia*.

The type specimen of *Jobinia canoi* is a leafless tangle of green shoots with flowers too large for an *Orthosia*. However, two more specimens were discovered, one, *Herrera 2086* (Fig. 3), showing both well-developed leaves and the typical rather large (to 7 cm), slightly spreading two mericarps of *Jobinia*. We were unable to sequence an accession from this scant material to further address its relationships.

Additional specimens examined. PERU. **Ancash Region:** Carhuaz Distr., Huascarán Nat. Park, Quebrada Honda, valley bottom, 9°19′S, 77°28′W, 3600–3800 m, *Smith et al. 11689* (USM). **Ucayali:** Calca, Valle de Urobamba, 3000 m, *Herrera 2086* (S).

2. Jobinia chlorantha (K. Schum.) Malme, Ark. Bot. 25A(7): 3–4, tab. 2 & 3. 1932. Basionym: *Roulinia chlorantha* K. Schum, Bot. Jahrb. Syst. 25: 729. 1898. TYPE: Ecuador. Zamora-Chinchipe: Est. Cien. San Francisco, shortcut from

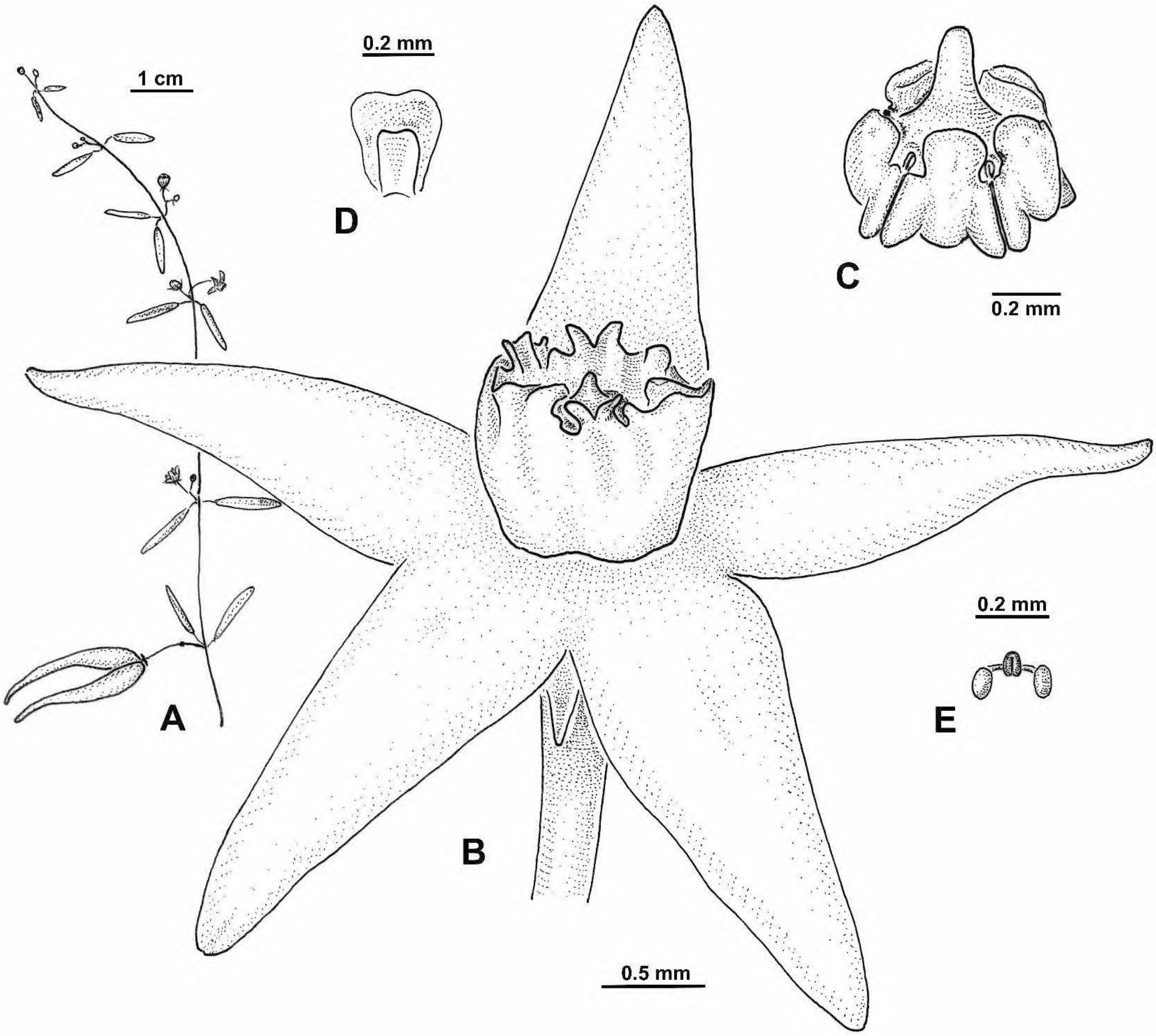


Figure 4. *Jobinia peruviana* Liede & Meve. —A. Plant with twin mericarps. —B. Flower, lateral view. —C. Gynostegium. —D. Corona lobe, adaxial view. —E. Pollinarium. A–E from holotype *Hutchinson & Wright 5439* (S). Drawn by U. Meve.

tarabita to path along channel, alt. 1850 m, 17 Feb. 2000, *S. Matezki 169* (neotype, designated here, UBT!). Figure 10B.

The type specimen of *Jobinia chlorantha* dates back to the end of the 19th century (Schumann, 1898, as *Roulinia chlorantha* K. Schum.) and the collecting activities of L. Sodiro (*Sodiro 107/2*) on the Pichincha in the vicinity of Quito, Ecuador. The holotype as well as one additional specimen from there, *Sodiro 107/8* (photo in F), were housed in B and probably destroyed by the fire in 1942. Since then, this species has not been recollected in Ecuador. It was up to S. Matezki (*Matezki 169*) in 2000 and later D. Wolff (*Wolff 110*), in the course of research projects on vines and the reproductive biology of Rubiaceae and Asclepiadoideae in southern Ecuador, to relocate this species in the country after more than 100 years (Wolff et al., 2008). In choosing a neotype, we concentrated on these collections that originate from the same country as the lost holotype, and finally selected *Matezki 169* because this collection is represented in UBT by a flowering exsiccate as well as a spirit collection. The studies of Wolff et al. (2008) also yielded the first pollination observations for a *Jobinia* species, establishing that *J. chlorantha* is (predominantly) pollinated by small wasps (Ichneumonidae). In our molecular phylogeny (Fig. 1), *J. chlorantha* falls in the "Brazilian" clade. Considering floral morphology, this very small-flowered species is quite distinct from the remaining three species of the clade (see discussion under *J. latipes*). However, it shares with *J. lindbergii* the distinct ovate-elliptic corpuscles, bent and filiform caudicles, and ovoid pollinia.

Additional specimens examined. ECUADOR. **Zamora-Chinchipe:** Est. Cien. San Francisco (ca. 30 km E from

Loja), 20 Oct. 2001, *Wolff 110* (UBT); Est. Cien. San Francisco (ca. 30 km E from Loja), near the tarabita, 5 Oct. 2000, *Liede & Meve 3466b* (UBT).

3. **Jobinia fontellana** Liede & Meve, nom. nov. Replaced synonym: *Orthosia hatschbachii* Fontella & Goes, Revista Biol. Neotrop. 1(1–2): 1. 2004 [2005] non *Jobinia hatschbachii* Fontella & E. A. Schwarz, Bol. Mus. Bot. Munic. 51: 8–9, fig. 5–7. 1982. TYPE: Brazil. Paraná: Laranjeiras do Sul, Campo Novo, 8 June 1968, *G. Hatschbach & O. Guimarães 19295* (holotype, MBM not seen; isotypes, CTES not seen, MO-2878860!).

Morphologically, *Jobinia fontellana* shares characters with *J. latipes* and *J. hatschbachii*. However, it lacks the short and winged petioles and the pilose anthers of *J. latipes*, and its flowers maximally reach half the size of those of *J. latipes*. *Jobinia hatschbachii* has a yellow and shortly pilose corolla, whereas the corollas of *J. fontellana* and *J. latipes* are creamish or greenish and glabrous. In addition, the corona of *J. hatschbachii* is broader than long (< 1.5 mm), and apically nearly fused, obscuring the gynostegium, whereas in *J. fontellana* and *J. latipes* the corona is longer than broad (> 2 mm) but not as highly fused and not obscuring the gynostegium (Fontella Pereira & Britto de Goes, 2004).

4. **Jobinia formosa** (N. E. Br.) Liede & Meve, comb. nov. Basionym: *Cynanchum formosum* N. E. Br., Bull. Misc. Inform. Kew 1895: 112. 1895. TYPE: Peru. Arequipa, Apr. 1863 (fl., fr.), *M. Guillaume s.n.* (lectotype, designated here, K [barcode] 000195460!; isolectotype, K [barcode] 000197153!).

Cynanchum ecuadorense Schltr., Bot. Jahrb. Syst. 34 (Beibl. 78): 15–16. 1904. TYPE: Ecuador. In silvis vulc. Pululahua, *Sodiro 107/16* (lectotype, designated here, G [barcode] 00039950!).

Cynanchum eurystephanum Malme, Ark. Bot. 25A(7): 7–8, fig. 6. 1932. TYPE: Peru. Lima: prope Viscas 2000–2300 m, June 1925, *F. W. Pennell 14440* (holotype, S!; isotypes, NY!, US not seen).

Of the seven syntypes listed for *Cynanchum formosum* (*McLean s.n.*, K [barcode] 000197152!; *Carson s.n.*, K [barcode] 000197151!; *Guillaume s.n.*, K [barcode] 000195459!; *Guillaume s.n.*, K [barcode] 000195460!; *Pearce 84*, K [barcode] 000195454!; *Pearce s.n.*, K [barcode] 000195455!; *Pavon s.n.*, K [barcode] 000195450!), *Guillaume s.n.* (K [barcode] 000195460) was selected as lectotype, because it shows both flowers and fruits. According to label information, the specimen was raised at Kew from seeds received from M. Guillaume.

Schlechter (1904: 16) cites two subsequent Sodiro specimens as syntypes for *Cynanchum ecuadorense*: "[c]rescit in silvis subandinis montis ingivomi Pululahua (S. n. 107/15 et n. 107/16)." Neither specimen was encountered in B, but a specimen of *Sodiro 107/16* was encountered in G. Affixed to the specimen there is a label stating "Lectotipo de *Cynanchum ecuadorense* Schlechtr. G. Morillo, 1985." However, the lectotypification was never published. To honor Morillo's work and to avoid confusion, this specimen is selected as lectotype here.

Jobinia formosa is certainly the most widespread and frequent of all *Jobinia* species. Due to its rambling growth and luxuriant inflorescences, the taxon is often cultivated, and therefore its original distributional area is difficult to identify. However, all known collections come from Ecuador and Peru, so that it has to be considered an Andean species. The plant used for sequencing (Table 1) was found in a neglected garden along the Chilean coast, which is most likely outside the natural range of the species, since the species has never been reported from Chile or from coastal habitats. *Jobinia formosa*, while clearly a member of the *Jobinia* clade, took an isolated position in this clade. An additional specimen from the natural habitat of the species would ascertain this position.

Additional specimens examined. ECUADOR. **Chimborazo:** Interandine highland, Riobamba, *Rimbach 675* (NY); NE Riobamba, *Schimpff 742* (G, MO). **Guayaquil:** Huayaquil, *Pavon s.n.* (syntype, *Jobinia formosa*, K [barcode] 000197150). **Loja:** Loja, *Asplund 18114* (B, NY, R). **Pichincha:** In silvis prope Niebly, *A. Sodiro 107/15* (syntype, *Cynanchum ecuadorense*, QCNE); Niebly, *Sodiro 107b* (Q). PERU. s. loc. *J. McLean s.n.*, (syntype, *J. formosa*, K [barcode] 000197152). **Ancash:** Huaylas, 3.3 km SE of Pto. Pobre, ca. 27 km NW of Yungay, along Rio Santa, *Stevens 21977* (NY). **Arequipa:** 1855, *Carson s.n.* (syntype, *J. formosa*, K [barcode] 000197151). **Ayacucho:** Huanta prov., above Huanta, Apr. 1867, *R. Pearce s.n.* (syntype, *J. formosa*, K [barcode] 000197155). **Cajamarca:** Contumaza, carr. Cascas–El Chorrillo 07°30′S, 078°47′W, 1400 m, 22 Aug. 1994, *Merello et al. 1055* (M, MO); Sangal (San Pablo), 2000 m, *Sagástegui et al. 15365* (MO, NY). **Huánuco:** Huánuco, *Pearce s.n.* (syntypes, *J. formosa*, K [barcode] 000197153, K [barcode] 000197154). **Lima:** NE of Huinca, Santa Eulalia Rd., 11°50′S, 076°40′W, 2350–2450 m, *Gentry & Smith 36123* (AAU, MO, NY); Canta Rd. to Canta, Km. 74 near Yasoa to outside of Canta, 11°30′S, 076°45′W, 1800–2500 m, *Sullivan et al. 958* (MO, NY); Huarochirí, just above Matucana, Km. 80 on carr. Central, *Ugent & Ugent* 5301 (WIS); vic. of Matucana, *Rose & Rose 18666* (NY); Km. 72 on carr. Central betw. Lima & Oroya, 2000 m, *Stevens 22100* (GA, MO, NY); along slopes of carr. Central toward Lima, 11°50′S, 076°25′W, 2900–4100 m, *Sullivan et al. 1109* (MO, NY); S of Matucana along carr. Central, 11°50′S, 076°20′W, 2000–3000 m, *Sullivan et al. 864* (NY). **Otuzco:** La Libertad, Cascasday (Collambay–

Sinsicap), *Sagástegui et al. 15646* (MO, NY). **Moquegua:** Prov. General Sánchez Cerro rd. from Amate to San Francisco, above Omate, hillsides of Urimalle, 1840 m, *Ackermann & Cáceres 678* (M).

5. Jobinia latipes (Decne.) Liede & Meve, comb. nov. Basionym: *Metastelma latipes* Decne., Prod. 8: 513. 1844. *Cyathostelma latipes* (Decne.) E. Fourn., Fl. Bras. 6(4): 219. 1885. *Orthosia latipes* (Decne.) Malme, Svensk Bot. Tidskr. 22: 53. 1928. TYPE: Brazil. s.d., *C. F. P. von Martius s.n.* (holotype, M!).

Jobinia latipes, *J. hatschbachii*, *J. lindbergii*, and *J. chlorantha* form a very well-supported clade (MP/ML: 100% BS, BI: 1.0 PP), and *J. latipes* is retrieved, equally well supported, in sister group position to the remaining taxa. Except for *J. chlorantha*, an Ecuadorian species, the other three taxa come from southern Brazil and northern Argentina. However, the group is not yet sufficiently studied to understand the geographic patterns involved. Vegetatively, all four species representing this "Brazilian" subclade of *Jobinia* (Fig. 1) are fairly similar, sharing glabrous, elliptic, (sub)coriaceous leaves of very smooth surface and texture. The group is characterized by the formation of two (rarely three) conspicuously short and thick colleters at the base of the lamina, a character already mentioned by Fournier (1885) in the protologue of *J. latipes*. However, *J. latipes* is clearly distinct from the other species in the clade by the flattened, slightly winged petioles, to which the epithet "latipes" refers. These petioles are much shorter (10–20 mm long in material from Brazil [Malme, 1928], and only 6.5 mm long in Argentina [*Tressens et al. 6647*, UBT]) than the petioles in the other three species of the clade. Floral structure, in contrast, is rather variable in this clade. In most species, the corona surrounds the gynostegium, but in *J. chlorantha*, the strongly folded corona completely obscures a short stipe, so that the gynostegium appears to sit on top of the corona (Fig. 10B). Boletus-shaped style heads are characteristic for this clade, while the shortly pilose anthers (Fig. 10C) of *J. latipes* constitute a unique apomorphy within Asclepiadeae as a whole.

Additional specimen examined. ARGENTINA. **Corrientes:** Predio Guarani, 26°56′S, 054°15′W, 16 Oct. 2000, *Tressens et al. 6647* (CTES, UBT).

6. Jobinia mazzuchii (Speg.) Liede & Meve, comb. nov. Basionym: *Dicarpophora mazzuchii* Speg., Physis (Buenos Aires) 8: 270–271. 1926. *Cynanchum mazzuchii* (Speg.) Liede, Novon 7(2): 175. 1997. TYPE: Bolivia. Tupiza: Cult in horto Domini O. Reyes, Mar. et May 1926, *A. Mazzuchi s.n.* (lectotype, designated by Liede [1997: 175]; unnumbered figure in Spegazzini [1926: 271]).

Discussion. The single species of the genus *Dicarpophora* clearly represents a *Jobinia*, resembling closely *J. formosa* with its almost parallel twin mericarps, long-pedunculate inflorescences, and ovate, basally cordate leaves. As no extant material has been found and the quality of the photograph chosen as lectotype does not permit a close examination of the flower, it seems best to continue the recognition of this species.

7. Jobinia peruviana Liede & Meve, sp. nov. TYPE: Peru. Cajamarca: Celendin, Río Marañon opposite Balsas, river cliffs, ca. 800 m, 29 May 1964, *P. C. Hutchinson & J. K. Wright 5439* (holotype, S!; isotype, USM!). Figure 4.

Haec species a congeneris habitu humili fruticoso haud volubili, foliis parvis anguste ellipticis, inflorescentia depauperata atque floribus parvis distinguitur.

Plants erect to ascending, non-twining shrubs, to 50 cm high, sparsely branched, glabrous all over; shoots herbaceous, basally woody, with grayish bark; internodes 1.5–3 cm, 0.5–1.2 mm diam. Leaves with the petiole 1–2 mm, colleters absent; leaf blades 8–14 × 1.4–1.7 mm, narrowly elliptic, basally cuneate, apically obtuse, minutely mucronate, lateral veins seemingly absent. Inflorescences sciadioidal, 1- to 4-flowered, 1 or 2 flowers open synchronously, (sub)sessile to very shortly (–2 mm) pedunculate; floral bracts ca. 0.3 × 0.15 mm at the base, lanceolate, cream, abaxially glabrous, smooth; pedicels 2.5–3.5 mm, glabrous; floral buds ca. 2 mm, ca. 1.2 mm diam., ovoid. Calyx entirely free to basally fused, rotate, abaxially glabrous, with 2 colleters in sinuses, lobes ca. 1 × 0.4 mm, slenderly elliptic, apically acute; corolla rotate, ca. 3.5 × 5.5 mm; corolla lobes basally fused or fused to ca. 1/4 corolla length, ca. 1 mm wide, slenderly triangular, apically acute, horizontal to declined, abaxially yellow to greenish yellow (chartreuse, fide *Hutchinson & Wright 5439*); gynostegial corona tubular, of almost completely fused staminal lobes, ca. 1.2 mm, equaling the gynostegium, upper margin plicate, emarginate, lobes trilobate, erect, with a conspicuous adaxial thickening in staminal position and forming a pouch in interstaminal position; gynostegium ca. 0.5–0.6 long, ca. 0.5 mm diam., about as long as broad, sessile, conical; anthers ca. 200 µm, wider than long, abaxially gibbous and slightly basally arched, anther wings ca. 200 µm, extending the length of the anther, at a ca. 25° angle, in the same plane as anther; connective appendages ca. 160 × 160 μm, broadly deltate, slightly inflexed; corpusculum ca. 65 × 50 μm, broadly ovoid; caudicles ca. 40 μm, straight, horizontal, attached at ca. 1/2 of corpusculum length; pollinia subapically attached to the caudicles, ca. 85 × 50 μm, ellipsoid, vertical; style head ca. 500 × 500 μm diam., upper portion ca. 300 μm, longer than the lower part, ob-infundibuliform, and apically slightly bifurcate. Follicles normally 2 per flower, with a sharp angle between them, horizontal to erect, to 30 × 3 mm, obclavate, apically strongly beaked, light brown, glabrous.

Phenology. *Jobinia peruviana* was collected in flower and with fruits in May.

Discussion. *Jobinia peruviana* is known only from the type collection. The new species is a rather atypical *Jobinia* because of its small, shrubby habit; small, narrowly elliptic leaves; and depauperate inflorescences with small flowers. Yet, molecular analysis places it clearly in *Jobinia* (Fig. 1), affined with a Peruvian accession of *J. streptantha* and an Ecuadorian accession of *J. tarmensis* (MP/ML: 88%/89% BS and BI: 0.99 PP), both species with morphologies more typical of the genus.

8. **Jobinia samuelssonii** (Malme) Liede & Meve, comb. nov. Basionym: *Cynanchum samuelssonii* Malme, Ark. Bot. 26A(4): 21–22. 1933. TYPE: Argentina. Tucumán: Dept. Francas, Pico de la Cuesta, ca. 1700 m, Apr. 1926, *S. Venturi 4439* (holotype, S!; isotype, MO not seen, MO-1232935 digital image!). Figure 5.

Apparently, this species has been collected only once. Its large, glabrous leaves (3–5[–6.5] × 2–3 [–4.5] cm), multiflowered inflorescences, fused corona, and rostrate style head place it clearly in *Jobinia*. Meyer (1944: fig. 69) published a full-page lithograph of the type plant (sub *Cynanchum samuelssonii*) in Descole's monumental treatment of Argentinean Asclepiadoideae.

9. **Jobinia schizocorona** (Liede & Meve) Liede & Meve, comb. nov. Basionym: *Cynanchum schizocoronum* Liede & Meve, Novon 11(2): 171, fig. 1. 2001. TYPE: Ecuador. Chimborazo: thickets, 1200–1500 m, 20 Feb. 1955, *E. Asplund 15474* (holotype, S!).

Jobinia schizocorona was described under *Cynanchum* from just two collections from Ecuador. Unfortunately, no sequenceable material of the species could be retrieved. But its habit as small twining climbers; ovate, slightly cordate leaves; absence of prophylls; and a sciadioidal inflorescence structure show that it is best treated as a member of *Jobinia*. The species is characterized by a cyathiform corona, which is folded along the upper two thirds of its length and possesses strongly lacerate margins.

10. **Jobinia streptantha** (Malme) Liede & Meve, comb. nov. Basionym: *Cynanchum streptanthum* Malme, Ark. Bot. 25A(7): 8–9, tab. 7. 1932. *Oxypetalum streptanthum* (Malme) Liede & G. H. Rua, Novon 7(1): 41. 1997. TYPE: Ecuador. Pichincha: Machachu, 2800 m, 12 Nov. 1920, *I. Holmgren 950* (holotype, S!).

Jobinia streptantha belongs to a small group of superficially *Cynanchum*-like plants in South America that has been moved between various genera. In the concept presented here, it is morphologically and molecularly clearly a member of *Jobinia*. The conspicuously obclavate, erect twin follicles, together with the long rostrate style head, which misled Liede and Rua (in Liede & Meve, 1997) to affine the taxon within *Oxypetalum*, fit very well into the present concept of *Jobinia*. *Jobinia streptantha* is retrieved with very good support (MP/ML: 95%/96% BS, BI: 1.00 PP) as sister of *J. tarmensis* (Fig. 1); both are fairly robust plants with coriaceous leaves bearing two conspicuously large colleters at the base of the lamina. Florally, however, the two species are quite dissimilar, except that they both possess a rostrate style head.

Cynanchum longirostrum (K. Schum.) W. D. Stevens is likewise a member of this group of species, as Stevens (1988) correctly pointed out. Because its holotype (Ecuador. Guayas: prope Naranjito, Aug. 1891, *A. Sodiro 107/3*) has been lost in B and only a photograph of the holotype could be traced in F!, the name cannot be formally transferred to *Jobinia*. However, closer inspection of the photograph revealed that the plant depicted shares with *J. streptantha* the stout stems (main stems to 4 mm diam., side branches to 2.5 mm diam.), the narrow spacing of the leaves along the side branches, shape and size of the leaves, and the almost globular, many-flowered inflorescences. Details of floral structure, however, are not visible. From the protologues, it can be gathered that the flowers of *C. longirostrum* are slightly smaller than those of *J. streptantha* (e.g., corolla lobes 5.3 mm vs. 8–9 mm long), but not fundamentally different in structure. Both species are recorded from Ecuador. It is therefore likely that *C. longirostrum* in its original circumscription is identical to or at least very closely related to *J. streptantha*.

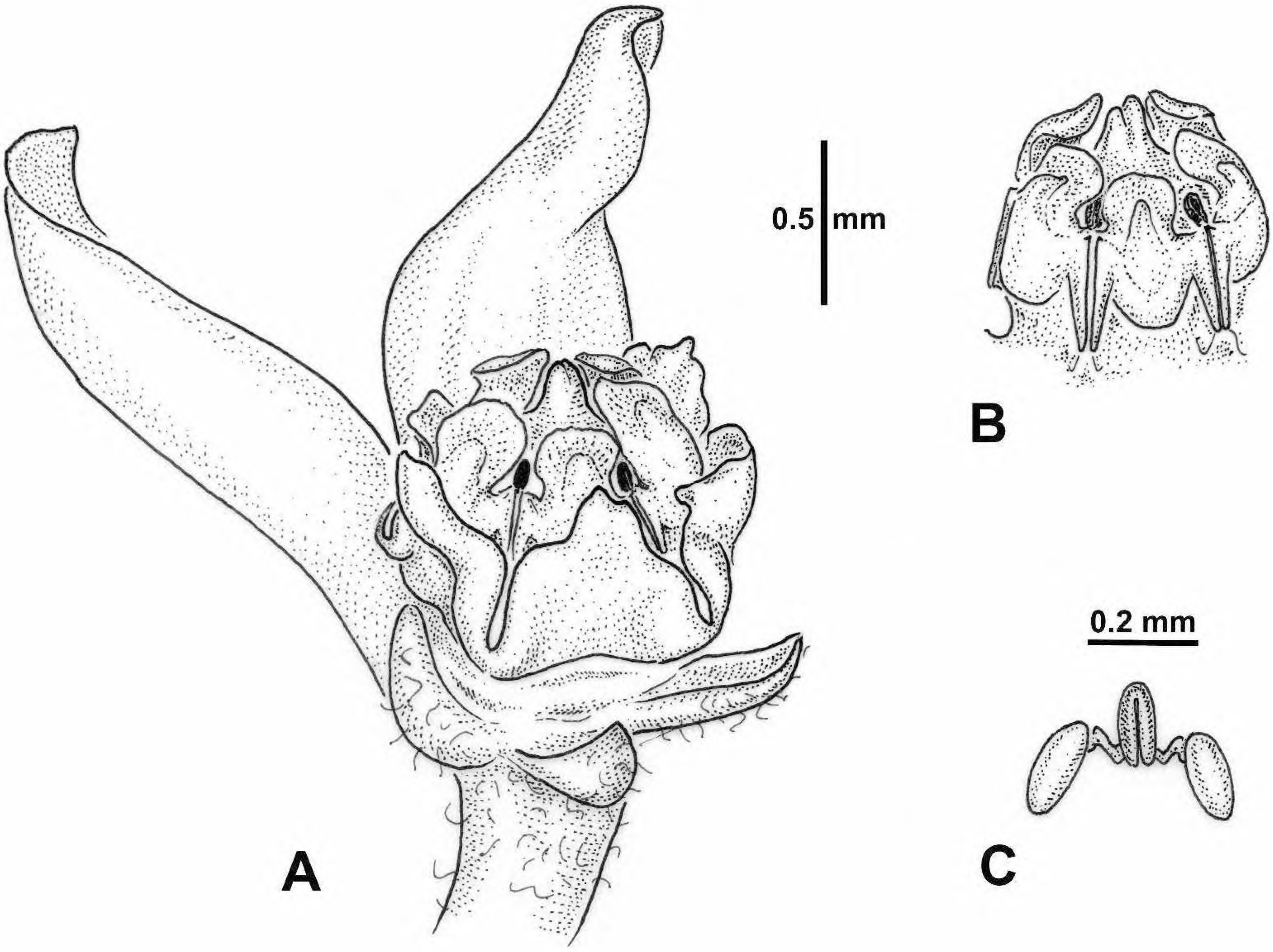


Figure 5. *Jobinia samuelssonii* (Malme) Liede & Meve. —A. Flower, lateral view. —B. Gynostegium. —C. Pollinarium. A–C from holotype *Venturi 4439* (S). Drawn by U. Meve.

Additional specimens examined. BOLIVIA. **Cochabamba:** Carrasco, ca. 0.5 km from Monte Puncu toward Sehuencas, 2900 m, *Wood 10318* (K); 2700 m, *11557* (K, UBT); Quillacollo, Chorojo, 3600 m, 28 Aug. 1990, *Hensen 887* (USZ); Arque Prov., Sihuyalla, 3300 m, 5 Jan. 1992, *Ibisch 832* (LPB). ECUADOR. **Bolívar:** above Guaranda, ca. Km. 10 to Riobamba, 01°37′S, 58°57′W, 2880 m, *Liede & Meve 3550* (UBT).

11. Jobinia tarmensis (Schltr.) Liede & Meve, comb. nov. Basionym: *Cynanchum tarmense* Schltr., Bot. Jahrb. Syst. 37: 621. 1906. TYPE: Peru. Junin Region: Tarma, *A. Weberbauer 1740* (lectotype, designated here, G!). Figure 10D.

Of the two syntypes given by Schlechter, only one, *Weberbauer 1740*, could be traced in G and is selected as the lectotype. The other syntype, *Weberbauer 1790*, was not located. *Jobinia tarmensis* is one of the two more frequent *Jobinia* species and has been recorded from Peru, in the regions of Ancash, Apurí, Cajamarca, Cuzco, Huánuco, Junín, La Libertad, and Pasco. A record from the northern Ecuadorian Province of Carchi, based on *Boom et al. 1399* (AAU!, QCNE!, US not seen) and cited by Jørgensen and Ulloa Ulloa (1994: 88) is based on a misidentification: the specimen in question represents a *Scyphostelma* and is closest to *S. pichinchensis*. A further collection from Ecuador cited by Jørgensen and Ulloa Ulloa (1994: 88), *MacBryde 357* (QCA!, US not seen), is sterile and the specimen too poor to positively identify, but leaf shape does not agree with *J. tarmensis*. Thus, there is as yet no confirmed record of *J. tarmensis* from Ecuador. *Jobinia tarmensis* is well characterized by fairly large radiate-subcampanulate flowers with broadly deltoid corolla lobes and long, spreading, ribbon-shaped, apically emarginate corona lobes (Fig. 10D; see also the discussion under *J. streptantha*).

Additional specimens examined. PERU. **Huánuco:** 2 km SW of La Union (along old rd.), 3180 m, 26 Sep. 2000, *Liede & Meve 3452* (UBT). **Lima:** rd. from Yauyos to Jauja, after Tomas, 2300 m, 7 Oct. 2002, *Weigend, Ackermann & Cano 7250* (HUSA, M, NY, SB, UBT, USM).

12. Jobinia tiarata (Malme) Liede & Meve, comb. nov. Basionym: *Cynanchum tiaratum* Malme, Ark. Bot. 25A(7): 7, tab. 5. 1932. TYPE: Peru. Arequipa: La Union, Alca near Cotahuasi, ca. 2800 m, Mar. 1914, *A. Weberbauer 6875* (lectotype, designated here, MO!; isotypes, F not seen, NY!, P!).

Jobinia tiarata, of which no material for sequencing was available, is a rare Peruvian endemic. With its multiflorous and lax inflorescences, also found in other species of *Jobinia* (e.g., *J. balslevii*, Fig. 2A), and large (to 8 mm long) flowers with a long tubular corona, it is highly reminiscent of *J. formosa*. However, while the corona in *J. formosa* is nearly completely fused, plicate, and emarginate, the corona in *J. tiarata* is not plicate, and only fused for about half its length, and crowned (hence the name) by five long, slenderly lanceolate, free and erect lobules.

Additional specimen examined. PERU. **Arequipa:** Calloma, 15°39′S, 071°50′W, 3300–4000 m, 22 Apr. 2006, *H. van der Werff et al. 20923* (MO).

13. **Jobinia trifurcata** (Griseb.) Liede & Meve, comb. nov. Replaced synonym: *Cynanchum argentinense* Liede, in R. Govaerts, World Checkl. Seed Plants 3(1): 21. 1999. Basionym: *Metastelma trifurcatum* Griseb., Abh. Königl. Ges. Wiss. Göttingen 24: 227. 1879. *Cynanchum trifurcatum* (Griseb.) Lillo, Physis 4: 423. 1919, nom. illeg,. non *Cynanchum trifurcatum* Schltr., Bull. Herb. Boissier 4: 448–449. 1896. TYPE: Argentina. Prov. Catam: Juntas, Quebrada de Choya, Nov. 1872, *F. Schickendantz 48* (lectotype, designated here, GOET!). Figure 10E.

Although the holotype specimen at B is no longer extant, a duplicate in GOET could be traced and is designated as lectotype here.

Jobinia streptantha, *J. umbellata*, and *J. trifurcata* belong to a group of species that are very difficult to separate from each other morphologically. The three species share a delicate, whitish corolla with triangular to lanceolate pointed lobes and a rostrate style head. *Jobinia streptantha* and *J. umbellata* (see also discussion under these species), however, can be separated from *J. trifurcata* s.l. by a stronger, more rigid habit, thicker stems with broadly elliptical leaves, and compact sciadioidal inflorescences. *Jobinia trifurcata* s.l. plants, in contrast, represent thin-stemmed twiners with membranous, lanceolate, and long-acuminate leaves and less compact inflorescences with longer peduncles and petioles. Plants of this stature, however, show considerable variation in flower structure, and we assume that one or two additional undescribed species are hidden in this South Andean complex. Typical *J. trifurcata* (*Liede-Schumann et al. 3636*, Fig. 10E) from Argentina has the smallest flowers, with short, triangular corolla lobes (ca. 2 mm long); an emarginate, shortly lobed corona; ovoid anthers (fertile part); bent, S-shaped caudicles; and a very short style head rostrum (not exceeding 0.5 mm in length). A plant from Bolivia sequenced here and in Liede-Schumann et al. (2005) under "*Cynanchum longirostrum*" (*Wood & Goyder 15578*) has larger flowers with longer and smaller corolla lobes (ca. 4 mm long), lingulate and notched corona lobes (free for more than 1 mm), rectangular anthers (fertile part), a considerably longer rostrum (> 2 mm long), but also bent, S-shaped caudicles. A third element (e.g., *Wood 8727*, Bolivia) is intermediate between these two with regard to the corolla, with a corona that is more deeply divided into five separated lobes but without lingulate extensions and ovoid anthers as in *J. trifurcata* s. str., and a style head rostrum of intermediate length (0.8–1 mm). In contrast to the other two elements, however, the pollinaria have straight (not bent) caudicles, and the pollinia are ovoid (instead of slenderly obovate). In our molecular study, the three accessions of this group defined by flower morphology are not monophyletic, but group according to distribution with very good support (for *J. streptantha* in sister-group position to *J. tarmensis* [MP/ML: 99%/96% BS and BI: 1.00 PP] and for the group of *J. trifurcata L 3636*, *J. umbellata*, *Jobinia* sp. *Wood 15587*, and *J. trifurcata Wood 15308* [MP/ML: 97%/99% BS and BI: 1.00 PP]). *Wood 15308* (Bolivia) and *Liede et al. 3636* (Argentina) unquestionably belong to *J. trifurcata* s. str. morphologically, even though they are not retrieved as monophyletic, whereas *Wood & Goyder 15578* (Bolivia), one of the differing and unnamed elements, is sister to *J. trifurcata* from Bolivia (*Wood 15308*).

Additional specimens examined. ARGENTINA. **Catamarca:** Comasí, La Junta, 1960 m, *Jørgensen 1162* (MO, SI). **Córdoba:** Chelecito, entre Miranda y Bordo Atravesa (Ruta 40: Km. 546), *Hunziker 22669* (CORD); Cruz del Eje, Falda E de Sierra Grande, El Mirador, antes de Cuchilla Nevada, al N de los Gigantes, *Hunziker 8794* (CORD). **La Rioja:** Capital, Mina del Cantadero, 2000 m, *Meyer s.n.* (SI); betw. Bordo Atravesa & Miranda, in a little gorge, 2000 m, *Liede-Schumann et al. 3636* (CORD). **San Juan:** Angaco, Sierra de la Pie de Palo, subiendo por el camino al Mogote Los Corralitos, en la Quebrada del Molle, *Hunziker et al. 23862* (CORD). **San Luis:** Sierra del Morro, *Pastore s.n.* (SI). BOLIVIA. **Chuquisaca:** E side of Cerro Chataquila, 3400 m, *Wood 8727* (K); Azurduy, in gorge below La Angostura, ca. 4 km below Azurduy, 2500 m, *Wood et al. 15308* (K, UBT).

14. **Jobinia umbellata** (Rusby) Liede & Meve, comb. nov. Basionym: *Vincetoxicum umbellatum* Rusby, Mem. Torrey Bot. Club 6: 78. 1896. Replacement name: *Cynanchum rusbyi* Malme, Ark. Bot. 25A(7): 9. 1932. Non *Cynanchum umbellatum* Vell., Fl. Flumin. 120: 3. 1825 [1829]; Fl. Flumin. Icones 3: tab. 73. 1827 [1831]. *Oxypetalum rusbyi* (Malme) Liede & Meve, Novon 11(2): 173, fig. 2. 2001. TYPE: Bolivia. Sorata, Nov. 1892, *M. Bang 1620*

(lectotype, designated here, US [barcode] 00112345!; isolectotypes, F!, GH!, MICH not seen, MO!, NY!, US [barcode] 00623894!).

Rusby (1896) wrote: "Vic. Sorata, Nov., 1892 (1620). The same as Mandon's no. (*356*?) and also collected by Pearce in Bolivia." From this statement, it becomes clear that he regarded *Bang 1620* as the type collection and the other two collections (*Mandon 356* and *Pearce s.n.*) as paratypes and did not cite all three collections as syntypes. Therefore, the lectotype has to be selected among the numerous duplicates of the *Bang 1620* collection and not, as argued in Liede and Meve (2001: 173) among the duplicates of *Mandon 356*.

Malme (1932) pointed out the similarity of *Jobinia streptantha* with *J. umbellata*. Both species share a twisted corolla and long style head, so that they were both transferred to *Oxypetalum* subg. *Cryptodus* (E. Fourn.) T. Mey. (Meyer, 1943), the only *Oxypetalum* group without translator appendages. Both species also possess a gynostegial corona of fused staminal and interstaminal lobes, but they differ in the staminal lobes exceeding the interstaminal lobes in *J. streptantha*, whereas both reach the same length in *J. umbellata*. Further, the pollinaria of *J. umbellata* are nearly twice as large as those of *J. streptantha*. Finally, the follicles differ considerably, being obclavate with a long beak in *J. streptantha* but fusiform and with a short beak at the most in *J. umbellata*. Both species are clearly placed in *Jobinia* by molecular analysis (Fig. 1), though on different subclades. This placement is better supported by leaf shape and habit than one in *Cynanchum* (lacking prophylls) or *Oxypetalum* (lacking translator appendages).

Additional specimens examined. BOLIVIA. S. loc., *Pearce s.n.* (NY). **La Paz:** Vic. Sorata, Feb. 1860, *Mandon 356* (S); Saavedra, just below bridge, ca. 11 km below Charazani on rd. to Apolo, 2700 m, *Wood 15445* (K); just above Laripata, on rd. ca. 10 km from Sorata to Mapiri, 3300 m, *Wood in Goyder 15798* (K). PERU. **Cajamarca:** Contumazá, entrada de Bosque Cachil, 2500 m, *Sagástegui et al. 15124* (F).

II. **Monsanima** Liede & Meve, gen. nov.

Hoc genus inter genera subtribus *Orthosiinarum* quoad laminam foliarem linearem usque lanceolatam etiam inflorescentiam plerumque foliis breviorem *Orthosiae* Decne. et *Scyphostelmati* Baill. similis, sed ab eis antherarum alis basaliter valde centrifugis per antherae longitudinem totam non productis atque corona in tubum apice inflexum gynostegium occultantem connata distinguitur.

Plants as slender twiners. Inflorescences pedunculate. Flower with a corona of highly fused staminal lobes, folded inward atop the gynostegium; gynostegium with short, strongly centrifugal anther wings; pollinaria with short, broad, horizontal translator arms. Fruits solitary, spindle-shaped.

Distribution. As far as is currently known, *Monsanima* comprises only one species, *M. morrenioides* (Goyder) Liede & Meve, a narrow endemic restricted to the Pico das Almas, Bahía, Brazil.

Monsanima morrenioides, well illustrated in the protologue of *Cynanchum morrenioides* Goyder (Goyder, 1993: fig. 1A–D), is morphologically similar to some Madagascan *Cynanchum* species, like *C. obovatum* (Decne.) Choux, with its highly fused corona that obscures the gynostegium. However, this taxon is molecularly clearly distinguished as a member of the MOOG alliance (Liede-Schumann et al., 2005). For Goyder (1993), the fruits were still unknown; however, one specimen of *M. morrenioides*, *Atkins et al. (CFCR 14739)*, revealed an apparently solitary mericarp, ca. 8 cm long, spindle-shaped, and with a long beak. This is by far the most common fruit type in the MOOG alliance; in Orthosiinae, however, it is found only in *Monsanima* and some *Scyphostelma* species, while *Jobinia* and *Orthosia* have paired fruits as a rule.

Etymology. The genus name refers to the only known locality at the Pico das Almas.

Included species. The solitary taxon in this genus is *Monsanima morrenioides* (Goyder) Liede & Meve.

1. **Monsanima morrenioides** (Goyder) Liede & Meve, comb. nov. Basionym: *Cynanchum morrenioides* Goyder, Kew Bull. 48: 21, fig. 1. 1993. TYPE: Brazil. Bahia: Mun. Agua Quente, Pico de los Almas, 1250 m, 16 Dec. 1988, *R. M. Harley, B. Stannard, J. R. Pirani & A. Furlan 27541* (holotype, SPF not seen; isotype, K!). Figure 10A.

Additional specimen examined. BRAZIL. **Bahia:** Rio de Contas, Estrade entre o Distr. Mato Grosso e o pé do Morro de Itabira, 1400–1600 m, 1 Mar. 1994, *S. Atkins, C. M. Sakuragui, R. M. Harley, P. T. Sano & V. C. Sousa sub CFCR 14739* (SPF).

III. **Orthosia** Decne., Prodr. [DC.] 8: 526. 1844. TYPE: *Orthosia congesta* (Vell.) Decne., Prodr. [DC.] 8: 527. 1844 [≡ *Cynanchum congestum* Vell.].

Since its recognition as a taxonomic unit independent of *Cynanchum* by Liede (1997), *Orthosia* has been understood as a medium-sized genus in the Orthosiinae, with approximately 31 species widely spread from southern North America to central Argentina. Its taxonomic history has been lately summarized in Liede-Schumann and Meve (2008), and a species-level revision by the same authors is well advanced. However, the molecular results presented here (Fig. 1A) show that the present morphological circumscription of the more widespread species is often not delimiting monophyletic groups (e.g., *O. scoparia*, *O. bonplandiana*, *O. ellemannii*), requiring more detailed analyses both from the molecular and the morphological angle. The molecular results indicate clearly, though, that one taxon described by Schlechter (1916) as *O. thymifolia* Schltr., is not a member of the genus *Orthosia*, nor of the Orthosiinae, but rather belongs to the Metastelmatinae (Fig. 1B). Our one accession from Peru nests with three other taxa in *Ditassa* R. Br. and is thus affined within the Metastelmatinae. Therefore, the species is transferred to *Ditassa* here.

Included species. The 31 taxa of *Orthosia* are listed here; those included in the molecular analysis are indicated in boldface. ***Orthosia angustifolia*** (Turcz.) Liede & Meve [≡ *Metastelma angustifolium* Turcz.], ***O. bonplandiana*** (Schult.) Liede & Meve, ***O. calycina*** (Schltr.) Liede & Meve, *O. cardozoi* (Morillo) Liede & Meve, *O. cassythoides* (Suess.) Liede & Meve, ***O. congesta*** (Vell.) Decne., *O. cynanchoides* W. D. Stevens, *O. dusenii* (Malme) Fontella, *O. eichleri* E. Fourn., ***O. ellemannii*** (Morillo) Liede & Meve, *O. extra-axillaris* W. D. Stevens, *O. guilleminiana* (Decne.) Liede & Meve, *O. henriqueana* (Silveira) Liede & Meve, *O. itatiaiensis* Malme, ***O. kunthii*** Decne., *O. loandensis* Fontella & C. Valente, ***O. meridensis*** (Morillo) Liede & Meve, *O. parviflora* (E. Fourn.) Liede & Meve, ***O. pearcei*** (Rusby) Liede & Meve, ***O. pubescens*** (Greenm.) Liede & Meve, *O. ramosa* W. D. Stevens, ***O. scoparia*** (Nutt.) Liede & Meve, *O. selloana* (E. Fourn.) Liede & Meve, *O. smaragdina* W. D. Stevens, *O. stannardii* (Morillo) Liede & Meve, *O. stenophylla* Schltr., *O. stipitata* W. D. Stevens, *O. umbrosa* Decne., ***O. urceolata*** E. Fourn., ***O. virgata*** (Poir.) E. Fourn., ***O. woodii*** Meve & Liede.

1. **Orthosia angustifolia** (Turcz.) Liede & Meve, comb. nov. Basionym: *Metastelma angustifolium* Turcz., Bull. Soc. Imp. Naturalistes Moscou 25: 315. 1852. TYPE: Mexico. Veracruz: Mirador, 1000 m, Oct. 1838, *J. Linden 1353* (lectotype, designated by Liede & Meve [2008: 205], P!).

Orthosia angustifolia is a narrow endemic from the state of Veracruz, Mexico, where it grows in dense tangles at forest margins. It was included in the synonymy of *O. guilleminiana* by Liede and Meve (2008), but differs by more slender leaves (length: width ratio of 7.5–8.25 vs. 2.8–4) and inconspicuous, but constant, gynostegial characters. Its trapezoidal anthers are as long as the gynostegium and possess slender, nonprotruding anther wings, whereas the hemispherical anthers of *O. guilleminiana* are only half as long as the gynostegium, but display massive, protruding anther wings. Geographically, *O. angustifolia* takes an intermediate position between *O. kunthii* to the north and *O. guilleminiana* to the south. From *O. kunthii*, *O. angustifolia* differs by a corona shorter than the gynostegium, with apically truncate, vaguely trifid lobes, as opposed to a corona at least equaling the gynostegium in length, with acute to acuminate lobes.

Additional specimens examined. MEXICO. **Veracruz:** Orizaba, 8 Jan. 1867, *Botteri 2038* (P); Coatepec, 15 Aug. 1981, *Flügel & Geiseler 6023* (B); Coyame, ca. de Catemaco, 180 m, 22 Jan. 1972, *Hernandez 1384* (MEXU); 6 km en linea recta al W de San Carlos en el camino al Cerro del Diente, 1000 m, 25 Aug. 1994, *Martínez & Martínez 2457* (MEXU); 8 km NE Catemaco, 510 m, 6 Dec. 1981, *Nee 23736* (NY); Coatepec, bridge over Rio Pixquiac, 1250 m, 19 Sep. 1986, *Nee 33059* (NY, TEX); Zacuapan, Corral de las Piedras, Oct. 1906, *Purpus 2219* (NY); Xalapa, Parque "Las Tecachetes," 19 Oct. 2008, *Reyes A-5219* (MEX).

IV. Scyphostelma Baill., Hist. Pl. 10: 252. 1890. TYPE: *Scyphostelma granatensis* Baill., Hist. Pl. 252. 1890.

Cynanchum L. sect. *Microphyllum* Liede, Novon 7(2): 176. 1997. TYPE: *Cynanchum microphyllum* Kunth.

Liedea W. D. Stevens, Novon 15(4): 622. 2005. TYPE: *Liedea filisepala* (Standl.) W. D. Stevens.

The holotype of *Scyphostelma granatensis* is *Goudot s.n.* (P!) from Colombia, and the genus was monotypic until this treatment. The generitype reveals a plant with distinct long and short shoots and small, coriaceous, heart-shaped leaves, both densely covered with trichomes. The almost sessile, open-campanulate flowers bear two rows of trichomes on the adaxial side of the corolla lobes. The gynostegium is seated atop a stipe, and the prominent guide rails extend over the whole length of the anther, curving outward at the base along spreading, pointing, basal extensions of the anthers. Dorsally, the anthers are keeled, whereas the staminal corona is restricted to a short erect tooth that is confluent with the anther keel. With this character combination, although unique within Asclepiadoideae, the previously monospecific genus fits well with the concept of *Cynanchum* sect. *Microphyllum* Liede (Liede, 1997). The present paper confirms the position of members of *Cynanchum* sect. *Microphyllum* within the Orthosiinae, but outside of *Cynanchum* and Cynanchinae, respectively. It formalizes the transfer of 23 *Cynanchum* species, two *Orthosia* species (*O. ecuadorensis* Schltr., *O. trianae* Schltr.), and one *Liedea* W. D. Stevens species (*L. filisepala* (Standl.) W. D. Stevens). This paper focuses on taxa that have been used for molecular analysis herein, or have been attributed to *Cynanchum* sect. *Microphyllum* previously (Liede, 1997; Liede & Meve, 2001), or are needed for the publication of the Catálogo de las Plantas de Colombia. Additionally, we sequenced material from six taxa that may represent undescribed taxa based on their robust affiliation within *Scyphostelma* and the Orthosiinae (Fig. 1A). *Scyphostelma* is the oldest name available for this broad assemblage of species. *Scyphostelma* presently comprises 27 species and is centered in the Andes. Numerous species so far described under "*Cynanchum*" in South America probably also belong to *Scyphostelma*, so that as many as 50 species may be expected in the genus. Flowers are mostly small (< 5 mm diam.), but highly variable in construction and coloration. Typically the corona is a bowl- to cup-shaped structure composed of five basally fused corona lobes; structural variations, such as a corona fused for more than half of its length (e.g., *S. carmenaemiliae* (Morillo) Liede & Meve), or corona lobes reduced to scales (e.g., *S. granatensis*) or corona lobes subdivided into two hardly fused lobules, resulting in a seemingly 10-partite corona (e.g., *S. bifida* (Liede & Meve) Liede & Meve) are rare. An adherence to a growth form of irregular long shoots that give rise to short shoots with very evenly distributed, distichous leaves is probably the best character to identify members of the genus, but, as is the case with all other characters checked, not all species follow this pattern (e.g., *S. harlingii*). Fruits are usually single, but occasionally also twin mericarps are formed. These, however, are fusiform and often with a fairly long beak, whereas those of *Orthosia* tend to be narrowly oblong to lineariform and with no more than a short beak. *Scyphostelma* is one of the least known genera in American Asclepiadoideae, and many species are as yet undescribed. A more detailed revision is underway by the authors.

Included species. The 27 species of *Scyphostelma* are listed here, plus six presumably new, unnamed taxa. Those included in the molecular analysis are indicated in boldface. ***Scyphostelma beckii*** (Morillo) Liede & Meve [≡ *Cynanchum beckii* Morillo], ***S. bifida*** (Liede & Meve) Liede & Meve [≡ *C. bifidum* Liede & Meve], *S. brachyphylla* (K. Schum.) Liede & Meve [≡ *C. brachyphyllum* K. Schum.], *S. carmenaemiliae* (Morillo) Liede & Meve [≡ *C. carmenaemiliae* Morillo], *S. chimboracensis* (Morillo) Liede & Meve [≡ *C. chimboracense* Morillo], *S. confusa* (R. W. Holm) Liede & Meve [≡ *C. confusum* R. W. Holm], ***S. ecuadorensis*** (Schltr.) Liede & Meve [≡ *Orthosia ecuadorensis* Schltr.], *S. filisepala* (Standl.) Liede & Meve [≡ *Metastelma filisepalum* Standl., *S. granatensis* Baill., ***S. harlingii*** (Morillo) Liede & Meve [≡ *C. harlingii* Morillo], *S. intricata* (K. Schum.) Liede & Meve [≡ *C. intricatum* K. Schum.], *S. isidrensis* (Morillo) Liede & Meve [≡ *C. isidrense* Morillo], ***S. lechleri*** (Morillo) Liede & Meve [≡ *C. lechleri* Morillo], *S. longecalicina* (Morillo) Liede & Meve [≡ *C. longecalicinum* Morillo], *S. luteynii* (Morillo) Liede & Meve [≡ *C. luteynii* Morillo], ***S. microphylla*** (Kunth) Liede & Meve [≡ *C. microphyllum* Kunth], *S. nubicola* (Morillo) Liede & Meve [≡ *C. nubicola* Morillo], *S. pichinchensis* (K. Schum.) Liede & Meve [≡ *C. pichinchense* K. Schum.], *S. ruizteranii* (Morillo) Liede & Meve [≡ *C. ruizteranii* Morillo], *S. serpyllifolia* (Kunth) Liede & Meve [≡ *C. serpyllifolium* Kunth], *S. siderocalyx* (Morillo) Liede & Meve [≡ *C. siderocalyx* Morillo], *S. sodiroi* (K. Schum.) Liede & Meve [≡ *C. sodiroi* K. Schum.], *S. tenella* (L. f.) Liede & Meve [≡ *C. tenellum* L. f.], *S. trianae* (Schltr.) Liede & Meve [≡ *O. trianae* Schltr.], *S. veleziae* (Morillo) Liede & Meve [≡ *C. veleziae* Morillo], ***S. velutina*** (Morillo) Liede & Meve [≡ *C. velutinum* Morillo], ***S. wurdackii*** (Morillo) Liede & Meve [≡ *C. wurdackii* Morillo], ***Scyophostelma*** **sp. indet. a, b, c, d, e, f** (all from Ecuador).

1. **Scyphostelma beckii** (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum beckii* Morillo, Ernstia 4(1–2): 3–4, 9. 1994. TYPE: Bolivia. La Paz: Murillo, NNE de La Paz, Valle de Zongo, bajando de la represa del lago Zongo 22.5 km, 2800 m, 2 Apr. 1988, *S. Beck 13819* (holotype, LPB!; isotype, MERF!).

With its short internodes, and thus very narrowly spaced leaves, and small, coriaceous, hirsute and heart-shaped, mucronate leaves with stout colleters at the base of the lamina, *Scyphostelma beckii* vegetatively is hardly distinguishable from species such as *S. granatensis* or *S. isidrensis* from Venezuela. Florally, *S. granatensis* is very different (see discussion above), while *S. isidrensis* and *S. beckii* can be distinguished only by details of the corona and the gynostegium (corona lobes rectangular-lingulate and sub-emarginate, and gynostegium higher than broad in *S. beckii*; corona lobes broadly obovate, trilobed, tipped by an incurved lobule, and gynostegium broader than high in *S. isidrensis*). Together with the Peruvian accession of *S. microphylla*, *S. beckii* forms one of the three unresolved, very well-supported main clades in *Scyphostelma*.

Additional specimens examined. BOLIVIA. **La Paz:** Murillo, 22 km below Zongo Dam by rd. along Zongo Valley, 3000 m, 7 May 2000, *Wood 16326* (K, UBT); Zongo-Valley, 23 km from top, 2850 m, 13 May 1993, *Liede & Conrad 3141* (MSUN, UBT, ULM).

2. **Scyphostelma bifida** (Liede & Meve) Liede & Meve, comb. nov. Basionym: *Cynanchum bifidum* Liede & Meve, Novon 7(1): 38–39, fig. 1. 1997. TYPE: Ecuador. Azuay: 1–2 km N of Nieves, Ceja forest, 3000–3100 m, 16 Nov. 1988, *G. Harling 25919* (holotype GB!; isotype, MO!). Figure 10F.

Scyphostelma bifida morphologically belongs to the group of species vegetatively characterized by a microphyllous growth form, and florally by a stipitate gynostegium raised from a corona staying close to the corolla. Uniquely, the corona lobes are completely divided (hence the name) so that the corona appears 10-lobed. Otherwise, this species is hardly distinguishable from *S. serpyllifolia*, where the corona lobes are only apically bifid. Molecularly, *S. bifida* belongs to the large clade of mainly Ecuadorian taxa.

Additional specimen examined. ECUADOR. **Azuay:** betw. Cajas pass "Tres Cruces" & Cuenca, 02°46′S, 79°11′W, 3580 m, 10 Nov. 2005, *Liede & Meve 3557* (UBT).

3. **Scyphostelma brachyphylla** (K. Schum.) Liede & Meve, comb. nov. Basionym: *Cynanchum brachyphyllum* K. Schum., Bot. Jahrb. Syst. 25(5): 726. 1898. TYPE: Ecuador. Pichincha: ad montem Pichincha, in silvis prope Tablahuasi, Sep. 1888, *Sodiro 107/12* (lectotype, designated here, P [barcode] 00644838!; isolectotype, G!).

Scyphostelma brachyphylla is vegetatively similar to *S. ecuadorensis*, included in the molecular analysis with its rather broad leaves covered by a dense, slightly yellowish indument. Florally, it is characterized by a long-stipitate gynostegium, as illustrated by Liede (1997: 177, fig. 2). The species was included in *Cynanchum* sect. *Microphyllum* by Liede (1997). As the holotype is obviously lost, the well-preserved isotype at P is selected as lectotype.

Additional specimen examined. ECUADOR. **Pichincha:** Mt. Pichincha, prope Nono, 20 May 1920, *I. Holmgren 654* (S).

4. **Scyphostelma carmenaemiliae** (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum carmenaemiliae* Morillo, Ernstia 2(1–2): 4. 1992. TYPE: Venezuela. Mérida: Carr. Estanques–El Molino, 17 km S de Estanques, 1650 m, 17 Mar. 1992, *G. Morillo, B. Eriksen & B. Ståhl 10800* (holotype, VEN!; isotype, MERF!).

The highly stipitate gynostegium in combination with a highly fused, membranous corona that surpasses the gynostegium led Liede and Meve (2001) to affine this species with *Cynanchum* sect. *Microphyllum*. The same characters now warrant its inclusion in *Scyphostelma* in the closer relationship of *S. bifida*, *S. brachyphylla*, *S. ruizteranii*, and *S. serpyllifolia*. *Scyphostelma carmenaemiliae* has a limited distribution in the high Andes of Venezuela, where it is found in montane forest and cloud forest.

Additional specimens examined. VENEZUELA. **Mérida:** Carr. Estanques El Molino, 17 km S de Estanquez, 3 Mar. 1992, *Morillo, Eriksen & Ståhl 10804* (MER, MERF). **Táchira:** Lobadera, Parque Cazadero, Carretera de Palo Grande a Minas de Carbón de Lobatera, 11 Dec. 1979, *Berti & Peña 569–979* (MER). **Trujillo:** Boconó, El Campamento, ca. 2000 m, 9–16 July 1998, *Stergios 17540* (PORT, UBT, US); Parque Nacional Guaramacal, sector quebrada Honda-Pele Ojo, El Santuario, 1950–2100 m, 2001, *Stergios & Carácas 18975* (PORT, UBT, US); Montañas de Misisí, carr. vieja Trujillo-Boconó, ca. 12 km by air NW of Boconó, 2000–2400 m, 6 July 1990, *Dorr, Barnett & Diaz P. 7286* (MERF).

5. **Scyphostelma chimboracensis** (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum chimboracense* Morillo, Ernstia 2(1–2): 5. 1992. TYPE: Ecuador. Chimborazo: rd. 4 km E of Alao, 78°27′W, 1°52′S, 3350–3500 m, May 1982, *B. Øllgaard, L. B. Holm-Nielsen, N. H. Andreasen, B. B. Larsen & L. P. Kvist 38042* (holotype, AAU not seen; isotype, MO!).

Scyphostelma chimboracensis is a smaller and almost glabrous version of *S. intricatum*, and, like the latter species, displays the typical long shoot–short shoot pattern of *Scyphostelma* and a stipitate gynostegium. It was considered a member of *Cynanchum* sect. *Microphyllum* by Liede (1997).

6. **Scyphostelma confusa** (R. W. Holm) Liede & Meve, comb. nov. Basionym: *Cynanchum confusum* R. W. Holm, Fieldiana 28: 505. 1953. TYPE: Venezuela. Mérida: "La Isla" above Tabay, 2285–2745 m, 18 May 1944, *Steyermark 56586* (holotype, F!; isotype, CAS!).

Liede and Meve (2001) placed this species in *Cynanchum* sect. *Microphyllum* because the character mix of adaxially pilose corolla lobes, corona lobes fused for more than one third of their length, and sessile, sciadioidal inflorescences affine it with taxa such as *Scyphostelma luteynii*. *Scyphostelma confusa* is well distinguished by its vertical, robust guide rails that are nearly double as long as the fertile part of the anthers and its narrowly ovoid pollinia that are apically attached to the caudicles.

7. **Scyphostelma ecuadorensis** (Schltr.) Liede & Meve, comb. nov. Basionym: *Orthosia ecuadorensis* Schltr., Bot. Jahrb. Syst. 37: 618. 1906. Replacement name: *Cynanchum densiflorum* W. D. Stevens, Phytologia 64(5): 333. 1988. Non *Cynanchum ecuadorensis* Schltr., Bot. Jahrb. Syst. 34 (Beibl. 78): 15. 1904. TYPE: Ecuador. "in fruticetis apertis prope Molleturo, in Andibus occid. Caucae" 2500–3000 m, Nov. 1890, *F. C. Lehmann 5646* (lectotype, designated

here, US [barcode] 00113249!; isolectotypes, G!, GH!, K!). Figure 6.

We regard the holotype (B) as destroyed. Of the studied isotypes of *Lehmann 5646*, the barcoded specimen in US (00113249) is the richest and best preserved and is therefore chosen as lectotype.

This species is easily recognizable by its heart-shaped, densely pilose leaves and multiflorous, subglobose inflorescences with as many as 20 to more than 50 flowers. The radiate flowers are fairly large, 6–8 mm in diameter, and densely pilose. The fleshy corona lobes are at least twice as long as the gynostegium, reaching over 2 mm. The folding of the corona lobes, with an adaxially double-keeled median region and abaxially strongly revolute margins in the basal half, is the most distinctive feature of the species (Fig. 6E). Molecularly, the species is placed in the large clade of Ecuadorian species.

Additional specimens examined. ECUADOR. **Chimborazo:** along E 60 from Riobamba to Bucay, 01°51′S, 78°53′W, 2950 m, 8 Nov. 2005, *Liede & Meve 3556* (UBT). **Loja:** 4 km W of Selva Alegre, Rd. Selva Alegre–Manú, primary montane forest, *Harling & Ståhl 26512* (GB, S).

8. **Scyphostelma filisepala** (Standl.) Liede & Meve, comb. nov. Basionym: *Metastelma filisepalum* Standl., Publ. Field Mus. Nat. Hist. Bot. Ser. 18: 956. 1938. *Cynanchum filisepalum* (Standl.) L. O. Williams, Fieldiana, Bot. 32: 36. 1968. *Liedea filisepala* (Standl.) W. D. Stevens, Novon 15(4): 622–623. 2005. TYPE: Costa Rica. Alajuela: entre San Ramón y La Palma de San Ramón, 30 June 1928, *B. Brenes 6179* (holotype, F not seen; isotype, NY!).

Scyphostelma filisepala is a highly unusual species in its floral structure, in which the long sepal lobes by far exceed the corolla, corona, and gynostegium. Liede (1997) placed this species in *Cynanchum* sect. *Microphyllum*, but Stevens (2005) argued that the long-pedunculate, sciadioidal inflorescences, the uniformly pubescent stems, and the high-climbing habit do not fit to the remainder of species attributed to *Cynanchum* sect. *Microphyllum*. However, long-pedunculate, sciadioidal inflorescences, while rare in *Scyphostelma*, have also been found in *S. harlingii*. Uniformly pubescent stems and high-climbing habit are found in several other species of *Scyphostelma* as well, e.g., *S. ecuadorensis*. Its growth form of densely leafy, distichous floriferous short shoots and long shoots with larger leaves, which are shed with age, make it a typical member of *Scyphostelma*, and the basally fused corona and general gynostegium structure support this conclusion. *Scyphostelma filisepala* is the only known species of *Scyphostelma* in Central America and probably has undergone a long period of isolation. Unfortunately, several attempts to obtain sequenceable material of this interesting species have failed.

Additional specimens examined. COSTA RICA. **Alajuela:** Cantón de San Ramón, Cordillera de Tilarán, Zapotal, Río Barranquilla, 1500 m, 7 Sep. 1993, *Bello & Cruz 5306* (MO). **Puntarenas:** Monteverde Cloud Reserve, Pacific slope, 1500 m, 23 Oct. 1986, *Haber & Bello 6042* (MO). PANAMA. **Chiriqui:** near Costa Rican border, 13 km by rd. S of Río Sereno, Finca Hartmann, 1400–1800 m, 12 May 1991, *Hensold 1018* (MO, NY).

9. **Scyphostelma harlingii** (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum harlingii* Morillo, Ernstia 2(3–4): 62–63. 1992. *Blepharodon harlingii* (Morillo) Liede & Meve, Novon 11(2): 173. 2001. TYPE: Ecuador. Zamora-Chinchipe: above Valladolid, on rd. to Yangana, mtn. rainforest, 2300 m, Feb. 1985, *G. Harling & B. L. Andersson 21422* (holotype, GB!).

Scyphostelma harlingii is a very distinctive *Scyphostelma* species, lacking the characteristic long and short shoots seen elsewhere in the genus. It displays large reddish flowers (more than 1 cm diam.) in a horizontal position borne on long pedicels (ca. 2 cm) and even longer peduncles (2–4 cm). Its corolla lobes are spreading to reflexed, membranous, and glabrous. Its staminal corona lobes are almost unfused and cut to spreading fringes. The single mericarps are fairly long (8–10 cm) and laxly pendent. With this character combination, the taxon was transferred to *Blepharodon* in an earlier study (Liede & Meve, 2001). Molecular analysis, however, places our Ecuadorian accession clearly into the *Scyphostelma* clade, where it stands isolated with an accession from Bolivia (*Wood 10297*), which might constitute a new species. *Scyphostelma harlingii* is typically confined to humid quebradas (ravines).

Additional specimens examined. ECUADOR. **Zamora-Chinchipe:** Est. Cient. San Francisco, Quebrada Milagro, *Liede & Meve 3460* (UBT); *Wolff 167* (UBT); 2300 m, *Wolff 57* (UBT); along T4, *Matezki & Homeier 174* (UBT). PERU. **Húanuco:** Húanuco, Carpish, *Ferreyra 16159* (USM).

10. **Scyphostelma intricata** (K. Schum.) Liede & Meve, comb. nov. Basionym: *Cynanchum intricatum* K. Schum., Bot. Jahrb. 25: 727. 1898. TYPE: Ecuador. Pichincha: prope Jiatillo, Sep. 1888 (fl.), *A. Sodiro 107/11* (lectotype, designated here, fragm. at F!).

With the holotype destroyed in B, the fragment housed in F is the only piece of original material

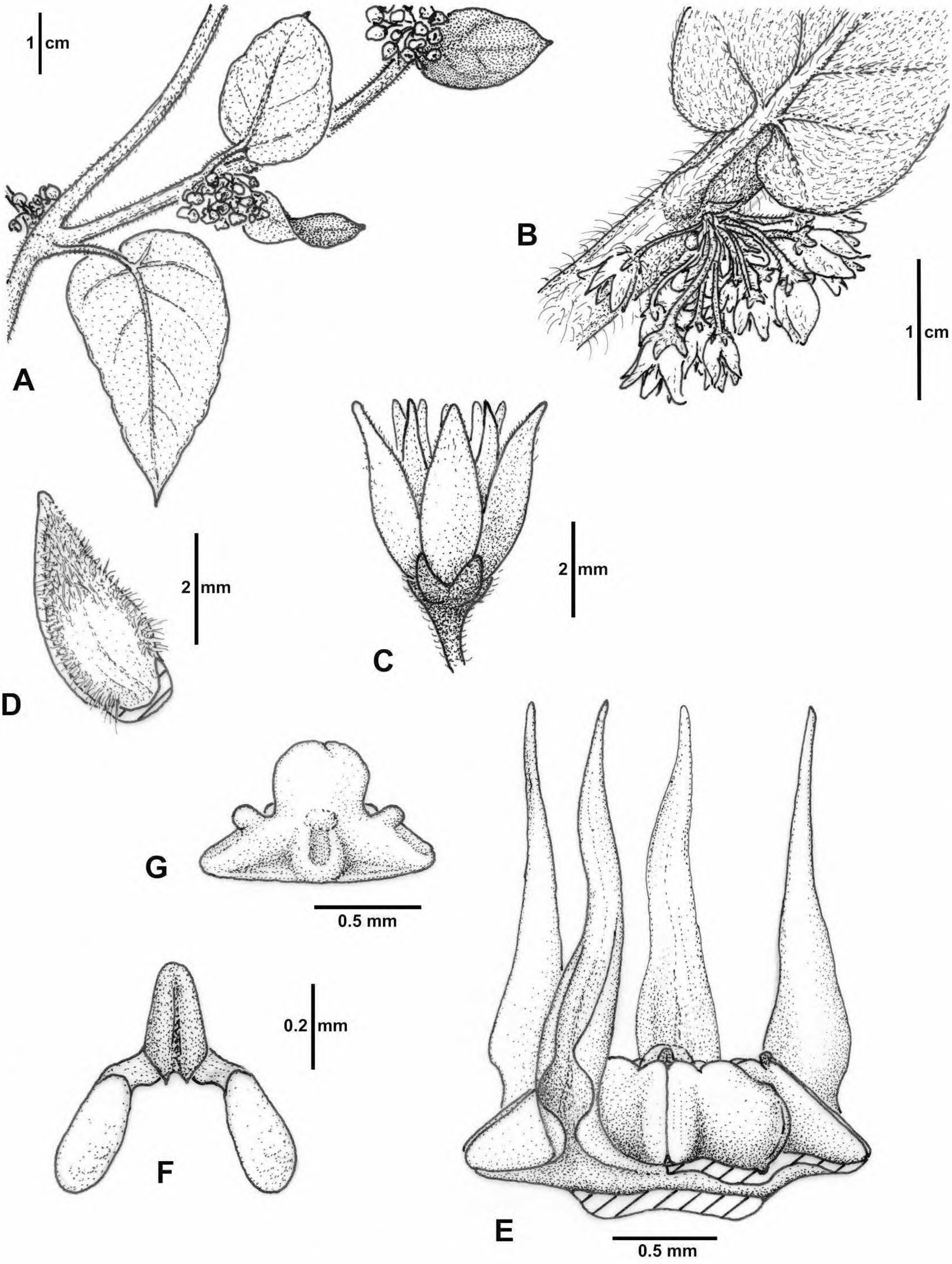


Figure 6. *Scyphostelma ecuadorensis* (Schltr.) Liede & Meve. —A. Branch with inflorescence. —B. Inflorescence. —C. Flower. —D. Corolla lobe, adaxial view. —E. Gynostegium. —F. Pollinarium. —G. Style head. A–G from isotype *Lehmann 5646* (US). Drawn by J. Conrad.

traced. However, as this fragment bears several flowers, it is chosen as lectotype here.

Scyphostelma intricata was listed among the members of *Cynanchum* sect. *Microphyllum* by Liede (1997). It is a typical *Scyphostelma* in habit, characterized by flowers with a highly stipitate gynostegium and five elongate, apically bipartite corona lobes. Its mericarps are at least occasionally paired, but their fusiform shape and long beak attribute them to *Scyphostelma. Scyphostelma intricata* is closely related to *S. brachyphylla*, *S. chimboracensis*, and *S. serpyllifolia*, but a more detailed study is necessary to disentangle this difficult species complex.

11. Scyphostelma isidrensis (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum isidrense* Morillo, Ernstia 2(1–2): 7, 14, fig. 1. 1992, as "*isidrensis*." TYPE: Venezuela. Mérida: betw. El Molino & ridge before descending to San Sidro Altro, alt. 2430–2895 m, *J. A. Steyermark 56256* (holotype, F not seen).

Scyphostelma isidrensis is vegetatively very similar to *S. beckii* from Bolivia, but differs in details of corona and gynostegium structure (see discussion under *S. beckii*). The protologue is accompanied by a full illustration.

Additional specimen examined. VENEZUELA. **Mérida:** 48 km from Estanquez, 6 Oct. 1998, *Liede & Meve 3320* (UTB).

12. Scyphostelma lechleri (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum lechleri* Morillo, Pittiera 23: 43. 1995. TYPE: Peru. Tabina, July 1854, *W. Lechler 2079* (holotype, P!; isotypes, K not seen, NY!, UPS!). Figure 7.

Ditassa subtrivialis Griseb., a nomen nudum (Lechler 1857: 58) is based on the same type. The locality of Tabina is not listed in modern gazettes; however, the name was a locality at Lechler's time, as the names *Andropogon tabina* Steud. (Poaceae), *Carex tabina* Steud., and *Cyperus tabina* Steud. (Cyperaceae) were all based on Lechler specimens. The Geranium Taxonomic Information System (Aedo, 2010) gives Tabina as a locality in Puno at 14°8′S, 69°32′W.

Scyphostelma lechleri displays the typical long shoot–short shoot construction of *Scyphostelma*. Its pilose adaxial corolla lobes and the short corona fused for around one third its length characterize the species in the genus. There is much resemblance with *S. confusa* from Venezuela with regard to corolla and corona (see also under *S. confusa*). However, notched corona lobes, a knobby style head, and very acute and rather erect anther appendages (Fig. 7) might be sufficient alone for delimitation of *S. lechleri*. Our Bolivian accession is included with strong support (MP/ML: 87%/84% BS, BI: 1.00 PP) in the large subclade comprising otherwise exclusively Ecuadorian accessions.

Additional specimen examined. BOLIVIA. **La Paz:** Sorata, 13 km from town on rd. to Batallas, 15°49′S, 66°58′W, 3180 m, 8 Mar. 1993, *Liede & Conrad 3136* (MSUN, ULM).

13. Scyphostelma longecalicina (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum longecalicinum* Morillo, Ernstia 2(3–4): 63–64. 1992. TYPE: Ecuador. Pichincha: Faldas occidentales del Volcán Atacazo, vegetación de Páramo secundaria y manchas de bosque con dominancia de *Polylepis sericea*, 3700–3800 m, 25 Nov. 1985, *B. B. Larsen 304* (holotype, GB not seen; isotypes, NY!, QCA not seen). Figure 8.

Scyphostelma longecalicina was included in *Cynanchum* sect. *Microphyllum* by Liede (1997) because of its characteristic habit and its clavate, long-beaked fruits unknown to Morillo (1992), which stand in an acute angle when paired. It differs from the other *Scyphostelma* species by rather large flowers (6–7 mm diam.) whose calyx lobes exceed the corolla tube considerably (Fig. 8).

14. Scyphostelma luteynii (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum luteynii* Morillo, Ernstia 2(3–4): 64. 1992. TYPE: Peru. Cuzco: Paucartambo, Paucartambo–Patria rd., 17–18 km NE of Paucartambo, along roadside slopes, alt. 3170 m, 9 Dec. 1978, *J. Luteyn & M. Lebrón-Luteyn 6436* (holotype, NY!; isotypes, AAU not seen, MO!).

Scyphostelma luteynii was included in *Cynanchum* sect. *Microphyllum* by Liede (1997) because of its characteristic habit and its clavate, long-beaked fruits, which stand in an acute angle when paired. It differs from the other *Scyphostelma* species by marginally and adaxially apically pilose corolla lobes, and a corona fused to about one third of its length combined with a stipitate gynostegium.

15. Scyphostelma microphylla (Kunth) Liede & Meve, comb. nov. Basionym: *Cynanchum microphyllum* Kunth, Nov. Gen. Sp. [HBK] (quarto ed.) 3: 204, tab. 236. 1818 [1819]. *Vincetoxicum microphyllum* (Kunth) Decne., Prodr. [DC.] 8: 525. 1844. TYPE: Ecuador. Prope Pasto, Nov., *A. Bonpland s.n.* (holotype, P!).

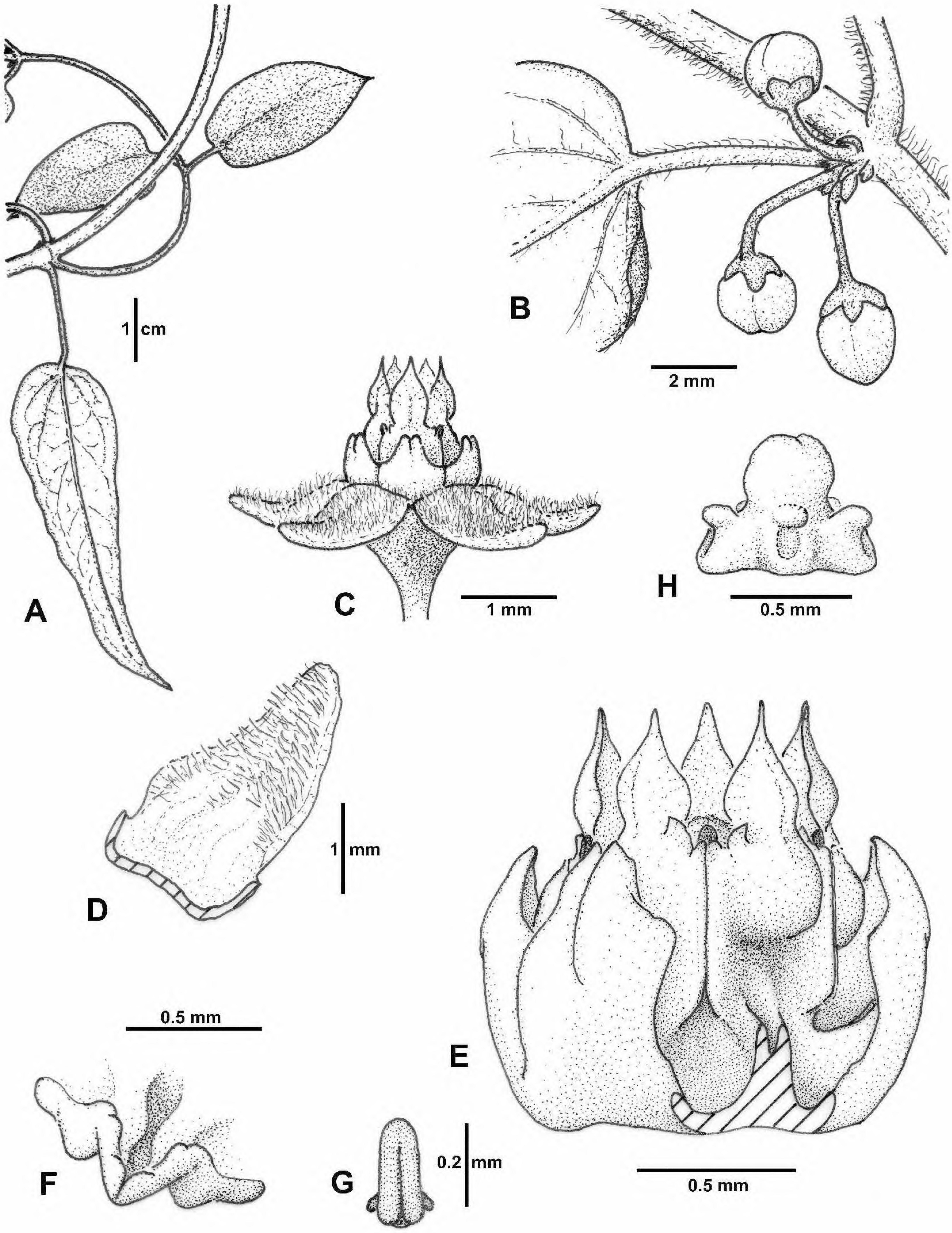


Figure 7. *Scyphostelma lechleri* (Morillo) Liede & Meve. —A. Branch with leaves. —B. Inflorescence. —C. Flower. —D. Corolla lobe. —E. Gynostegium with corona. —F. Basal guide rail opening. —G. Corpusculum. —H. Style head. A–H from isotype *Lechler 2079* (UPS). Drawn by J. Conrad.

Not immediately distinguishable from each other, *Scyphostelma microphylla* and *S. serpyllifolia* are among the most widespread and frequent *Scyphostelma* species in Ecuador, extending into Bolivia and Colombia. They represent well the concept of the genus with their almost leafless long shoots and distichous short shoots, which are often augmented by short shoots produced from adventitious buds. Their

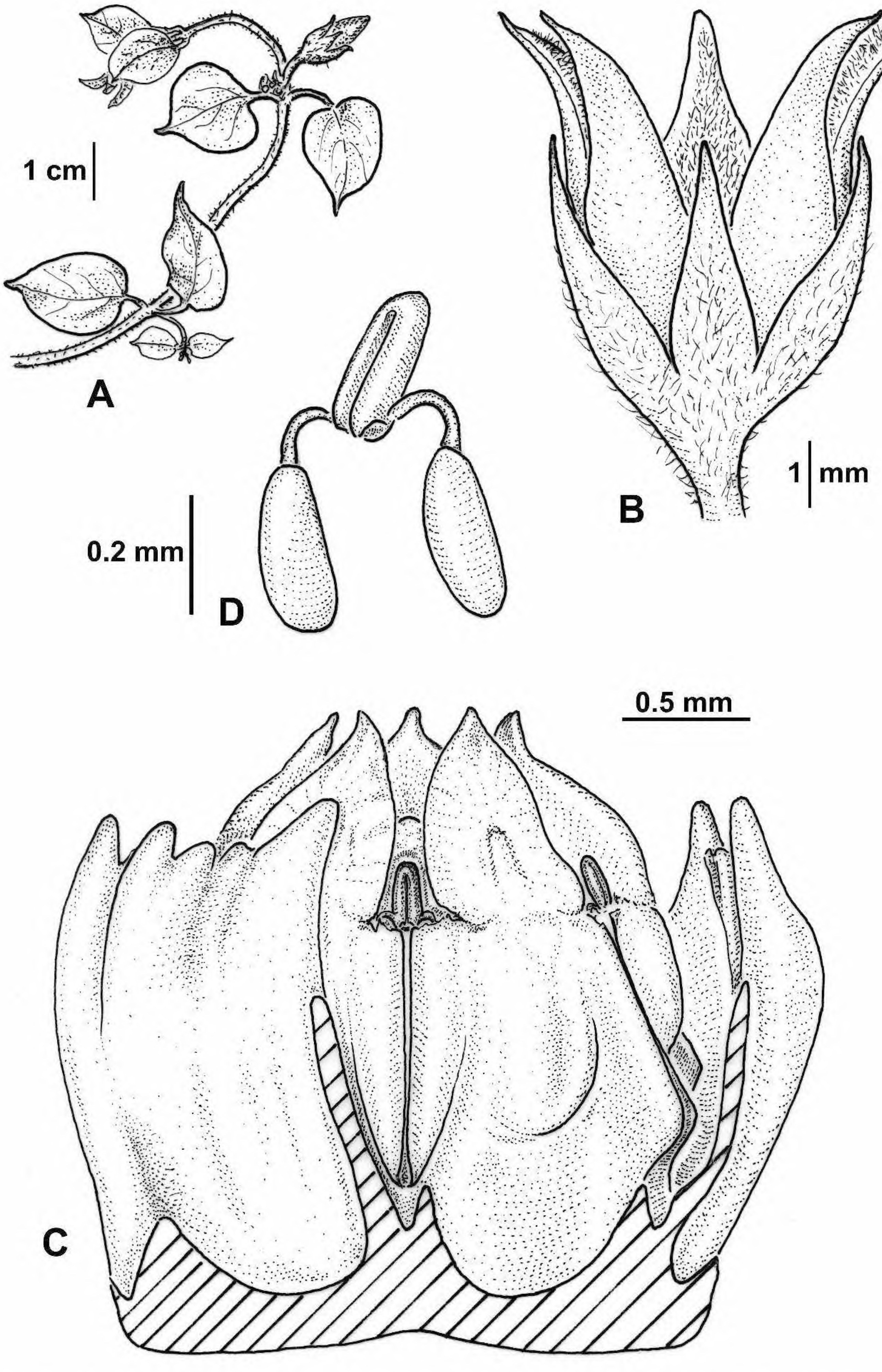


Figure 8. *Scyphostelma longecalicina* (Morillo) Liede & Meve. —A. Branch with leaves and flower bud. —B. Flower, lateral view. —C. Gynostegium with corona. —D. Pollinarium. A–D from isotype *Larsen 304* (NY). Drawn by J. Conrad, executed in ink by U. Meve.

flowers, also superficially very similar, can be distinguished based on gynostegium shape. The (sub-)sessile, broadly cylindrical gynostegium distinguishes *S. microphylla* easily from *S. serpyllifolia*, with its inversely pistilliform, stipitate gynostegium. Corona morphology seems to be fairly variable in *S. microphylla*, with entire or bifid corona lobes, and it is yet unclear how many discrete units might be distinguished in this complex. The single accession included in the molecular analysis (Ecuador, *Céron & Alcarón 12217*) is part of this complex, even though it differs from the type by adaxially pilose corolla lobes. It is a member of the well-supported clade (MP/ML: 87%/84% BS, BI: 1.00 PP) comprising predominantly Ecuadorian taxa. The taxon was illustrated in Humboldt and Bonpland (1818: tab. 236).

In the molecular analysis, a second accession originally identified by us as *Scyphostelma micro-*

phylla (*Weigend 5821*) from Peru was included. However, in contrast to the Ecuadorian accession (*Cerón & Alcarón 12217*), which is consistently a member of the large Ecuadorian clade, the former showed a very well-supported sister-group relationship to *S. beckii* from Bolivia. Upon re-inspection, it was found to differ in some aspects that had been considered minor at first, namely, a much denser indument on all vegetative parts, a dense pilose indument on the abaxial side of the corolla lobes and a scattered one on the adaxial side, and an unusually short (only ca. half of gynostegium length) corona. Together with the molecular differences, it seems best at present to treat this accession as representing a probably undescribed species (*Scyphostelma* sp. indet. f).

16. **Scyphostelma nubicola** (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum nubicola* Morillo, Ernstia 2: 8. 1992. *Metastelma nubicola* (Morillo) Liede, Novon 7: 43. 1997. TYPE: Venezuela. Trujillo: carr. Carrache–La Peha, 31.5 km E de Carache, 2000–2200 m, 28 Sep. 1988, *G. Morillo 10543* (holotype, VEN not seen; isotype, MERF not seen).

Scyphostelma nubicola is among the most easily distinguished microphyllous *Scyphostelma* species. Like *S. carmenaemiliae*, it possesses a long-stipitate gynostegium and baggy, rather spreading anther sacks. In contrast to *S. carmenaemiliae*, however, the corona consists of five barely fused lobes shorter than the stipe, and the whole structure is wrapped in a highly fused, ovoid-urceolate corolla. It was considered a member of *Cynanchum* sect. *Microphyllum* by Liede and Meve (2001), and is now transferred to *Scyphostelma*, where it joins the species swarm of the Venezuelan high Andes.

Additional specimens examined. VENEZUELA. **Trujillo:** Boconó. Montañas de Misisí, carr. vieja Trujillo–Boconó, ca. 12 km by air NW of Boconó, 2000–2400 m, 4 July 1990, *Dorr, Barnett & Díaz P. 7245* (MER, NY, VEN); 30 Oct. 1990, *Dorr & Barnett 7522* (NY).

17. **Scyphostelma pichinchensis** (K. Schum.) Liede & Meve, comb. nov. Basionym: *Cynanchum pichinchense* K. Schum., Bot. Jahrb. Syst. 25: 727–728. 1898. TYPE: Ecuador. Pichincha: "ad montem Pichincha in declivibus occidentalibus prope Palmira," Aug. 1873, *L. Sodiro 107/8* (lectotype, designated here, P!; isolectotype, G!).

The holotype at B was destroyed (photograph at F!), and of the duplicates available, the well-preserved specimen of P was chosen to serve as lectotype.

Although the leaves of *Scyphostelma pichinchensis* can grow rather large for the genus, up to 7 cm, the basally fused corona, which at least equals the gynostegium in length, and the characteristic construction of long and short shoots fit the genus well. The gynostegium is sessile with guide rails that at least double the lengths of the anthers. *Scyphostelma pichinchensis* is one of the more frequent members of the genus and is apparently widespread from Colombia to Bolivia.

Additional specimens examined. BOLIVIA. **Cochabamba:** ca. 3 km from Monte Puncu toward Sehuencas, 29 Dec. 1995, *Wood 10313* (K). COLOMBIA. **Santander:** Pamplona a Ducaramanga, páramo de Berlín, 30 May 1969, *Jaramillo 20005* (COL, GH, MA). ECUADOR. **Carchi:** ca. 50 km W Tulcán, 1 Oct. 2002, *Liede & Meve 3484* (UTB). PERU. **Ancash:** Huascarán National Park, Quebrada Ranincuray, 9°00′S, 77°33′W, 11 Jan. 1985, *Smith, Sanchez & Vidaurre 9036* (F, USZ).

18. **Scyphostelma ruizteranii** (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum ruizteranii* Morillo, Acta Bot. Venez. 16: 66. 1993. TYPE: Venezuela. Mérida: Rivas Dávila, Páramo Batallón, entre Portachuelo y Qda. La Mogral, 2850–2900 m, 7 May 1977, *L. Ruiz-Terán & A. Usubillaga 13501* (holotype, MERF!).

Scyphostelma ruizteranii, recognized by Liede and Meve (2001) as a member of *Cynanchum* sect. *Microphyllum*, belongs to the high Andean Venezuelan *Scyphostelma* alliance. Its stipitate gynostegium and baggy anthers affine it to *S. carmenaemiliae* and *S. nubicola*, but both the corona and the corolla are only basally fused. The species is known only from the type.

19. **Scyphostelma serpyllifolia** (Kunth) Liede & Meve, comb. nov. Basionym: *Cynanchum serpyllifolium* Kunth, Nov. Gen. Sp. [HBK] (quarto ed.) 3: 205. 1818 [1819]. *Orthosia serpyllifolia* (Kunth) Decne., Prod. [DC.] 8: 527. 1844. *Vincetoxicum serpyllifolium* (Kunth) Kuntze, Revis. Gen. Pl. 2: 425. 1891. TYPE: Ecuador. "crescit in umbrosis juxta Quito et in declivitate montis Pichinchensis, alt. 1600 m," *Humboldt & Bonpland s.n* (holotype, P!; photo ex P at F!).

Scyphostelma serpyllifolia has been confused often with *S. microphylla* because of far-reaching overall similarity in habit, inflorescence, and general floral appearance. However, the corona and gynostegium are distinctly different (see discussion under *S. microphylla*). As in other taxa of the microphyllous group of *Scyphostelma*, two flower color forms occur in *S. microphylla* and *S. serpyllifolia*, with the types representing the light-colored (whitish or yellowish) form, in contrast to the almost equally frequent purplish forms. Further, *S. serpyllifolia* shows a wide degree of variability considering indument density on the vegetative parts. For example, we observed glabrescent to densely pubescent plants within a single population (*Liede & Meve 3482*).

Additional specimens examined. ECUADOR. **Bolivar:** above Guaranda (ca. Km. 15 to Riobamba), 3450 m, 7 Nov. 2005, *Liede & Meve 3553* (UBT). **Carchi:** El Angel, along rd. to the private Reserva "Colorado," 3380 m, 30 Sep. 2002, *Liede & Meve 3482* (UTB).

20. Scyphostelma siderocalyx (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum siderocalyx* Morillo, Acta Bot. Venez. 16: 68. 1993. TYPE: Venezuela. Mérida: Miranda, entre Las Palmas y Las Gonzales, Páramo de Palmira, 3200–3300 m, 23 May 1975, *L. Ruiz-Terán & M. Dugarte 12226* (holotype, MERF!).

Scyphostelma siderocalyx has been recognized as a member of *Cynanchum* sect. *Microphyllum* by Liede and Meve (2001). With its highly stipitate gynostegium bearing baggy anthers, it belongs to the Venezuelan high Andean species swarm, next to *S. ruizterranii*, from which it is distinct only by the rusty indument on bracts, calyx, and pedicel, and the narrower and acuminate corona lobes. This species is known only from the type collection.

21. Scyphostelma sodiroi (K. Schum.) Liede & Meve, comb. nov. Basionym: *Cynanchum sodiroi* K. Schum., Bot. Jahrb. Syst. 25: 728. 1898. TYPE: Colombia. Cauca: entre Popayán y Puracé, junto al puente de Uarló, alt. 2600 m, 10 July 1939, *E. Pérez A. & J. Cuatrecasas 5890* (neotype, designated here, COL!).

The holotype of this species, *L. Sodiro 107/10*, was destroyed in B, and the photos of the type specimen that are preserved in F and G cannot serve as a formal type. The holotype originated from Ecuador: Pichincha, in "locis silvaticis prope Niebly." No further specimen of the type collection could be traced, and no new material has been collected in Ecuador. Therefore, a specimen from Cauca (Colombia), which fits the description by Schumann (1898) very well and has been identified as "*Cynanchum sodiroi*" by Woodson (following label information), is selected as neotype.

Of the *Scyphostelma* species found in Pichincha, *S. sodiroi* is characterized by corona lobes that are twice as long as the sessile gynostegium, an unusual feature in *Scyphostelma*. Vegetatively, the species resembles the much more widespread *S. pichinchensis*, a species in which corona lobes only just exceed the gynostegium.

22. Scyphostelma tenella (L. f.) Liede & Meve, comb. nov. Basionym: *Cynanchum tenellum* L. f., Suppl. Pl. 168. 1781. TYPE: Colombia. *J. Mutis 4088* (holotype, MA!; isotypes, NY!, P!, US!).

For discussion of *Scyphostelma tenella*, see *S. trianae* (below).

23. Scyphostelma trianae (Schltr.) Liede & Meve, comb. nov. Basionym: *Orthosia trianae* Schltr., Bot. Jahrb. Syst. 37: 621. 1906. TYPE: Colombia. Bogotá: Caqueza, 1700 m, *J. Triana 1933* (neotype, designated here, P [barcode] 00106972!).

Of *Scyphostelma trianae*, no type material (*J. Triana 1832*, B, NY) could be traced, except for the type photograph at NY, but the excellent description by Schlechter (1906) allows its identification in Colombian material. The sheet selected as neotype was collected by Triana himself close to Bogotá and bears numerous flowers.

On first sight, *Scyphostelma trianae* closely resembles *S. tenella*, also from Colombia, with distinct long and short shoots and sessile sciadioidal inflorescences. The flowers of both species are delicate, ca. 3 mm long and slender, with oblong and adaxially pilose, membranous corolla lobes. The corona lobes shortly exceed the elongated gynostegium that has stout, vertical guide rails, which are double as long as the anthers. However, while *S. tenella* is strictly unifariously pubescent, *S. trianae* possesses scattered trichomes in addition to the uni- to bifarious pubescence on stems and leaves. Pedicels and sepals are glabrous in *S. tenella*, but pubescent in *S. trianae*, and the pedicels of *S. trianae* are distinctly filiform and 6–10 mm long, whereas those of *S. tenella* are equally thin, but much shorter (to 4 mm). Corona lobes are smooth in *S. tenella*, but show two longitudinal adaxial keels in *S. trianae*. Most significant, the gynostegium, while completely sessile in *S. tenella*, is shortly stipitate (stipe 0.2–0.3 mm long) in *S. trianae*.

Additional specimens examined. COLOMBIA. **Bogotá:** Cordillera de Bogotá, 2800 m, *Triana 1922* (P). **Boyaca:** Arcabuco. Alto del Sote, ca. 2900–3100 m, 25 Dec. 1994, *Gonzáles 3238* (NY).

24. Scyphostelma veleziae (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum veleziae* Morillo. TYPE: Colombia. Depto. del Quindio, Mun. de Genova, camino a finca Servia–Valle

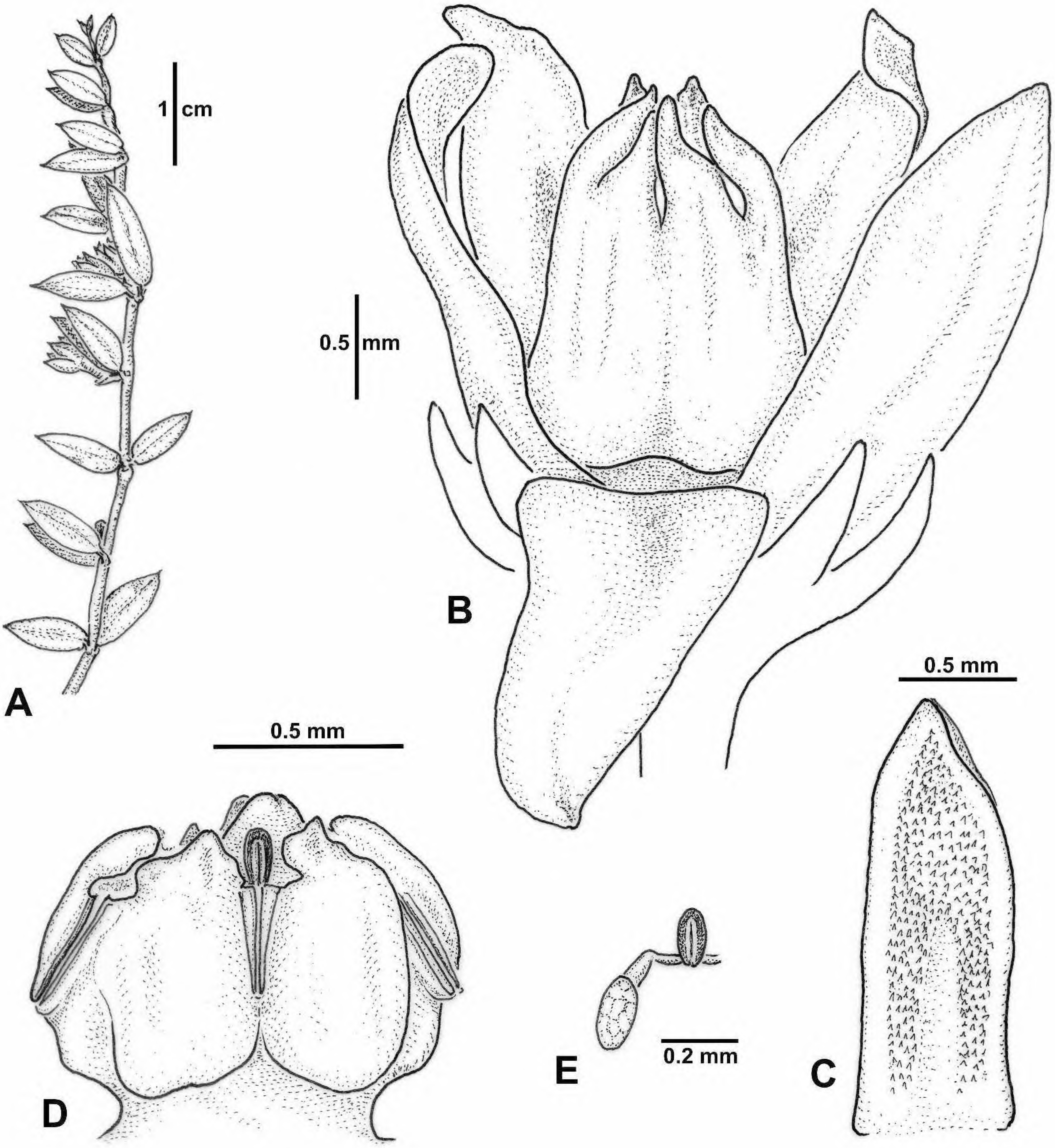
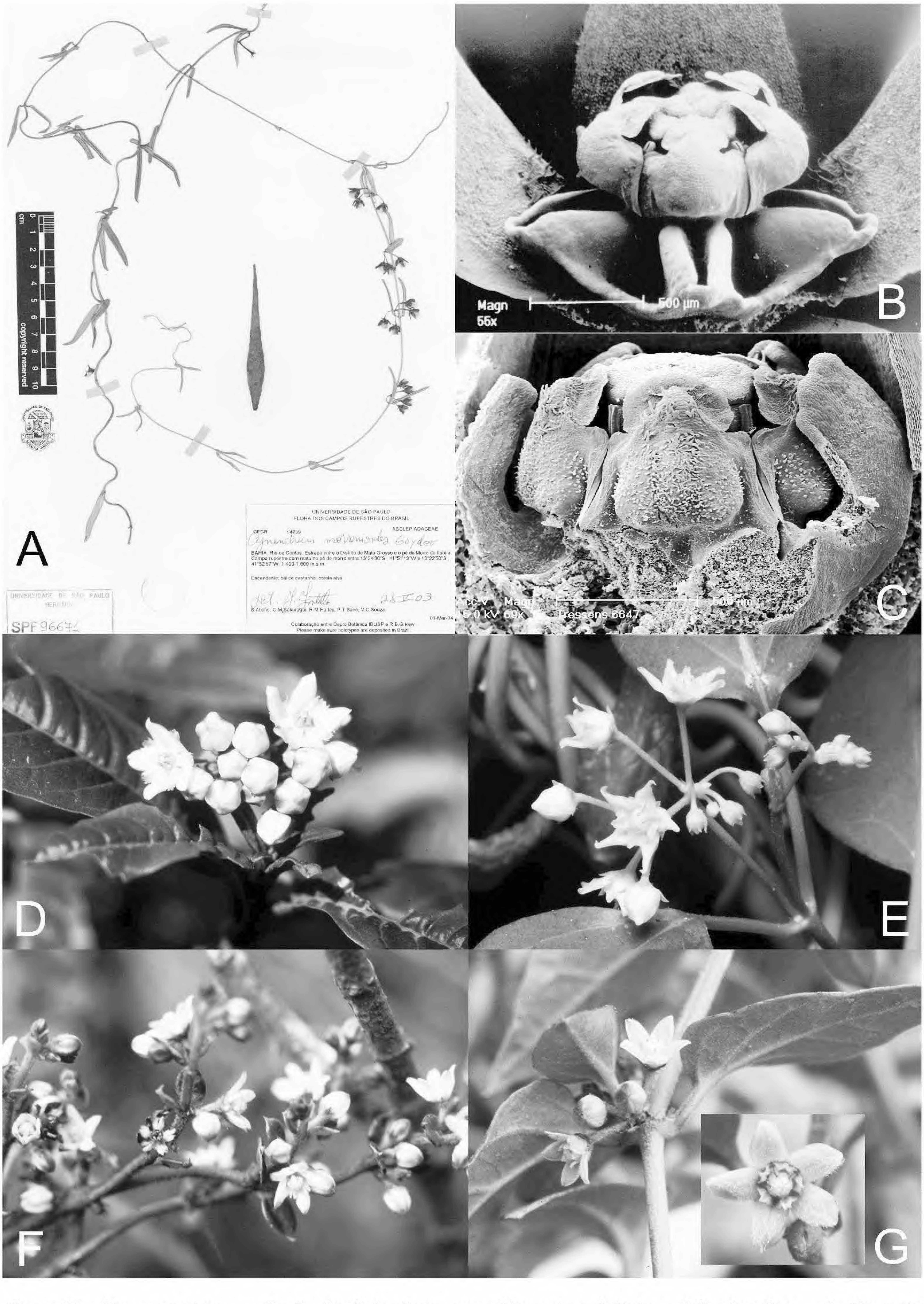


Figure 9. *Ditassa thymifolia* (Schltr.) Liede & Meve. —A. Flowering branch. —B. Flower. —C. Corolla lobe, adaxial view. —D. Gynostegium. —E. Pollinarium with one pollinium removed. A–E from lectotype *Weberbauer 6277* (US). Drawn by U. Meve.

Chiquitoen borde del bosque ante de llegar al subpáramo, 3000 m, 16 July 1990, *M. C. Vélez, C. A. Agudelo, L. F. Hoyos, V. M. Agudelo & N. J. Ocampo 2027* (holotype, HUQ not seen; isotypes, COL!, VEN!).

Scyphostelma veleziae is known only from the type collection in Colombia. It differs from its possible sister species in Ecuador, *S. brachyphylla*, by its dense indument on all vegetative parts in combination with corona lobes shorter than the gynostegium. From the Colombian endemic species pair *S. trianae* and *S. tenella*, *S. veleziae* differs by its glabrous, ovate-elliptical and rather stout corolla lobes of just 2 mm length and a distinctly stipitate (1 mm) gynostegium.

25. Scyphostelma velutina (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum velutinum* Morillo, Ernstia 2(3–4): 65. 1992. TYPE: Ecuador: Chimborazo: Pangor, Andes, Oct.



UNIVERSIDADE DE SÃO PAULO
FLORA DOS CAMPOS RUPESTRES DO BRASIL

CFCR 14739 ASCLEPIADACEAE

Cynanchum morrenioides Goyder

BAHIA: Rio de Contas. Estrada entre o Distrito de Mato Grosso e o pé do Morro do Itabira. Campo rupestre com mata no pé do morro entre 13°24'30"S, 41°51'13"W e 13°22'50"S, 41°52'57"W. 1.400-1.600 m.s.m.

Escandente; cálice castanho, corola alva.

28 II 03

S.Atkins, C.M.Sakuragui, R.M.Harley, P.T.Sano, V.C.Souza

01-Mar-94

Colaboração entre Depto Botânica IBUSP e R.B.G.Kew
Please make sure holotypes are deposited in Brazil

Figure 10. Representative examples for the Orthosiinae genera *Monsanima*, *Jobinia*, and *Scyphostelma*. —A. *Monsanima morrenioides*, specimen of *Atkins et al. sub CFCR 14739* (SPF). —B. *Jobinia chlorantha*, gynostegium with corona (SEM, from *Matezki 169*, UBT). —C. *Jobinia latipes*, corona (opened) showing gynostegium and shortly pilose anthers (SEM, from *Tressens et al. 6647*, UBT). —D. *Jobinia tarmensis*, flowering stem, from *Liede & Meve 3452* (UBT). —E. *Jobinia trifurcata*, flowering stem, from *Liede-Schumann et al. 3636* (CORD). —F. *Scyphostelma bifida*, flowering stem, from *Liede-Schumann & Meve 3557* (UBT). —G. *Scyphostelma pichinchensis*, from *Liede & Meve 3484* (UBT). All photographs by U. Meve.

1858, *R. Spruce 5578* (holotype, K!; isotype, BM!).

Scyphostelma velutina was included in *Cynanchum* sect. *Microphyllum* by Liede (1997) because of its characteristic habit. It belongs to the group of species with a dense yellowish indument on all vegetative parts and pilose exterior of corolla lobes. Not surprising, *S. wurdackii* is retrieved as sister species of *S. velutina* (Fig. 1) with very strong support in the molecular analysis. Both species are almost indistinguishable florally, but are easily separated by habit. *Scyphostelma velutina* branches scarcely and bears ovate(-elliptical) leaves covered by a regular velvety indument, with three to four lateral nerves protruding abaxially. *Scyphostelma wurdackii*, in contrast, develops numerous rather stiff, short shoots and bears small elliptical leaves that are discolorous due to the very dense tomentose indument on the abaxial side of the leaf that obscures the less prominent five to six lateral nerves.

Liede-Schumann and Meve re-collected this Ecuadorian endemic for the first time 147 years after the original collection of Spruce in 1858.

Additional specimen examined. ECUADOR. **Chimborazo:** along E 60 from Riobamba to Bucay, 3050 m, 8 Nov. 2005, *Liede & Meve 3555* (UBT).

26. **Scyphostelma wurdackii** (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum wurdackii* Morillo, Ernstia 2(1–2): 11–12. 1992. TYPE: Peru. Amazonas: Chachapoyas, moist ravine head, on middle E Calla–Calla slopes, 3–5 km SE of Km. 422, Leimebamba–Balsas rd., 3000–3200 m, 22 Aug. 1962, *J. J. Wurdack 1768* (holotype, K not seen; isotypes, G!, NY!, US!, USM!).

Scyphostelma wurdacki is one of the most characteristic *Scyphostelma* species, with its ovate, apically slightly mucronate leaves and its dense yellowish indument on the stems and lower leaf surfaces, resulting in a strong contrast between the dark green upper and the cream-colored lower leaf surfaces (see also remarks under *S. velutina*).

Additional specimen examined. ECUADOR. **Cuenca:** Parque Luis Fernando Carrion, 02°50′S, 79°09′W, 3200 m, 25 Oct. 1998, *Liede 3342* (UBT).

METASTELMATINAE

I. **Ditassa** R. Br., Asclepiadeae 38. 1810. TYPE: *Ditassa banksii* R. Br. ex Schult., Syst. Veg. 6: 112. 1820.

Ditassa is a large genus of Metastelmatinae in South America, comprising ca. 100 species, with about half of them from Brazil (Konno, pers. comm.). Based on molecular results, *Minaria* T. U. P. Konno & Rapini has been split from *Ditassa* recently (Konno et al., 2006). *Ditassa* is typically furnished with a gynostegial corona of free, rarely basally fused, staminal lobes, differentiated into a proximal and a distal lobule, but the proximal lobule can also be reduced or the corona can be completely absent, so that the morphological delimitation of the genus is still not finalized.

1. **Ditassa thymifolia** (Schltr.) Liede & Meve, comb. nov. Basionym: *Orthosia thymifolia* Schltr., Bot. Jahrb. Syst. 54(3, Beibl. 119): 2. 1916. *Cynanchum thymifolium* (Schltr.) Morillo, Ernstia 2(3–4): 69. 1992. TYPE: Peru. Piura: Linkes Seitental des Flusses Huancabamba bei Shumaya, 1700–1800 m, Apr. 1912, *A. Weberbauer 6277* (lectotype, designated by Morillo [1992: 69], US!). Figure 9.

The highly fused corona at first places this taxon in *Orthosia*, as correctly seen by Schlechter (1916). However, after molecular analysis clearly placed the species in Metastelmatinae, and there in *Ditassa*, the vegetative characters of an erect to scrambling shrublet; the small, rigid leaves; and the indument on the adaxial corolla lobes can be interpreted as supportive of a position in *Ditassa*.

Additional specimen examined. PERU. **Cajamarca:** Prov. Chota, Rd. Olmos to Jaén Bagua, E slope of Abra Porculla, 05°50′S, 079°29′W, 2035 m, 4 May 2006, *Weigend, Schwarzer et al. 8606* (B, UBT, USM).

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APPENDIX 1. List of species.

Ditassa banksii R. Br. ex Schult.
Ditassa thymifolia (Schltr.) Liede & Meve
Jobinia balslevii (Morillo) W. D. Stevens
Jobinia campii (Morillo) W. D. Stevens
Jobinia canoi (Morillo) Liede & Meve
Jobinia chlorantha (K. Schum.) Malme
Jobinia connivens (Hook. & Arn.) Malme
Jobinia eulaxiflora (Lundell) W. D. Stevens
Jobinia fontellana Liede & Meve
Jobinia formosa (N. E. Br.) Liede & Meve
Jobinia glossostemma (Lillo) Liede & Meve
Jobinia grandis (Hand.-Mazz.) Goes & Fontella
Jobinia hatschbachii Fontella & E. A. Schwarz
Jobinia latipes (Decne.) Liede & Meve
Jobinia lindbergii E. Fourn.
Jobinia longicoronata Goes & Fontella
Jobinia mazzuchii (Speg.) Liede & Meve
Jobinia neei (Morillo) Liede & Meve
Jobinia paranaensis Fontella & C. Valente
Jobinia peruviana Liede & Meve
Jobinia samuelssonii (Malme) Liede & Meve
Jobinia schizocorona (Liede & Meve) Liede & Meve
Jobinia streptantha (Malme) Liede & Meve
Jobinia tarmensis (Schltr.) Liede & Meve
Jobinia tiarata (Malme) Liede & Meve
Jobinia trifurcata (Griseb.) Liede & Meve
Jobinia umbellata (Rusby) Liede & Meve
Monsanima morrenioides (Goyder) Liede & Meve
Orthosia angustifolia (Turcz.) Liede & Meve
Orthosia bonplandiana (Schult.) Liede & Meve
Orthosia calycina (Schltr.) Liede & Meve
Orthosia cardozoi (Morillo) Liede & Meve
Orthosia cassythoides (Suess.) Liede & Meve
Orthosia congesta (Vell.) Decne.
Orthosia cynanchoides W. D. Stevens
Orthosia dusenii (Malme) Fontella
Orthosia eichleri E. Fourn.
Orthosia ellemannii (Morillo) Liede & Meve
Orthosia extra-axillaris W. D. Stevens
Orthosia guilleminiana (Decne.) Liede & Meve
Orthosia henriqueana (Silveira) Liede & Meve
Orthosia itatiaiensis Malme
Orthosia kunthii Decne.
Orthosia loandensis Fontella & C. Valente
Orthosia meridensis (Morillo) Liede & Meve
Orthosia parviflora (E. Fourn.) Liede & Meve
Orthosia pearcei (Rusby) Liede & Meve
Orthosia pubescens (Greenm.) Liede & Meve
Orthosia ramosa W. D. Stevens
Orthosia scoparia (Nutt.) Liede & Meve
Orthosia selloana (E. Fourn.) Liede & Meve
Orthosia smaragdina W. D. Stevens
Orthosia stannardii (Morillo) Liede & Meve
Orthosia stenophylla Schltr.
Orthosia stipitata W. D. Stevens
Orthosia umbrosa Decne.
Orthosia urceolata E. Fourn.
Orthosia virgata (Poir.) E. Fourn.
Orthosia woodii Meve & Liede
Scyphostelma beckii (Morillo) Liede & Meve
Scyphostelma bifida (Liede & Meve) Liede & Meve
Scyphostelma brachyphylla (K. Schum.) Liede & Meve
Scyphostelma carmenaemiliae (Morillo) Liede & Meve
Scyphostelma chimboracensis (Morillo) Liede & Meve
Scyphostelma confusa (R. W. Holm) Liede & Meve
Scyphostelma ecuadorensis (Schltr.) Liede & Meve
Scyphostelma filisepala (Standl.) Liede & Meve
Scyphostelma granatensis Baill.
Scyphostelma harlingii (Morillo) Liede & Meve
Scyphostelma intricata (K. Schum.) Liede & Meve
Scyphostelma isidrensis (Morillo) Liede & Meve
Scyphostelma lechleri (Morillo) Liede & Meve
Scyphostelma longecalicina (Morillo) Liede & Meve
Scyphostelma luteynii (Morillo) Liede & Meve
Scyphostelma microphylla (Kunth) Liede & Meve
Scyphostelma nubicola (Morillo) Liede & Meve
Scyphostelma pichinchensis (K. Schum.) Liede & Meve
Scyphostelma ruizteranii (Morillo) Liede & Meve
Scyphostelma serpyllifolia (Kunth) Liede & Meve
Scyphostelma siderocalyx (Morillo) Liede & Meve
Scyphostelma sodiroi (K. Schum.) Liede & Meve
Scyphostelma tenella (L. f.) Liede & Meve
Scyphostelma trianae (Schltr.) Liede & Meve
Scyphostelma veleziae (Morillo) Liede & Meve
Scyphostelma velutina (Morillo) Liede & Meve
Scyophostelma wurdackii (Morillo) Liede & Meve